Railway Shop Up To Date

Chapter VII

PASSENGER COACH AND PAINT SHOPS

IN considering the passenger car department, the paint and coach shops should be treated collectively. The nature of the work on passenger cars and the effect of dust and dirt on the finished surfaces requires that construction and painting should be done in different shop buildings. The class of work required and the length of time that a passenger car is held in the shop during repairs or the time consumed in construction, demands that cars and workmen must be thoroughly and carefully housed.

Passenger equipment is usually put through the shop once in twelve to fifteen months and as traffic is heaviest during three months of the year and requires practically all available equipment, it is considered on many roads that there are but nine months left for passenger car repair work.

To keep the men employed during the slack season and to provide an equilibrium of forces, it is not unusual for a certain amount of building to be done at car repair shops. The layout of the average passenger car repair shop is equally suitable for new car construction and there is information at hand of a passenger car department built for repair work having been operated for the construction of new cars during several years.

LOCATION.

Except at those shops where all principal departments are served by a single transfer table, there is a decided tendency to place the passenger car department in an isolated location where the transfer table pit will offer the least impediment to general yard traffic. At several shop plants of recent construction, maintaining both locomotive and car departments, the transfer table of the passenger car department is the only one on the property. Where the principal departments are grouped around a single transfer table, the coach repair and paint shops are usually on the same side of the transfer table pit, placing the buildings of the car department as compactly as possible. Where the passenger shops are served by an individual table the prevailing practice is to locate the coach and paint shops on opposite sides of the transfer table pit, in parallel buildings, with the table operating between them.

BUILDING.

The principal details of the coach and paint shop are very similar. Both shops require ample natural light to be admitted through the roof as well as through windows in the walls, and to be so diffused as to light the space between the tracks rather than immediately over them.

Modern passenger car shops have brick walls with large window area. Wooden roof trusses and supports, as well as steel, have been used in the construction in some of the most prominent shops. At Readville and at Angus the roof trusses and supporting columns are of wood and at Collinwood they are of steel.

Examination of the dimensions of a number of prominent shops shows that a width of 90 feet is provided for several shops having a standing capacity of one car per track; 100 feet for a number of others having the same capacity per track and the Readville shop, where three cars are stood per track, is 225 feet wide.

A clear height of 20 feet from floor to lower chord of roof truss is considered suitable in both the coach and paint shops. At some prominent shops this height is 19 feet and sometimes a few inches higher.

NATURAL LIGHTING.

A number of paint shops have saw tooth roofs and this type is considered particularly well adapted for the requirements of the paint shop. For the most satisfactory diffusion of light between the cars saw tooth skylights are arranged transversely with the tracks.

The provision of liberal natural lighting at Collinwood is worthy of special attention. The total amount of glass in the side and end walls of the buildings equals 45 per cent of the total wall area. The total glass area in both roofs and walls equals 75 per cent of the total floor area. In the roof of the paint shop is a skylight 42 feet 4 inches wide by 245 feet long in the monitor and to this is added 34 separate skylights 21 feet by 11 feet. This gives an area of glass equal to 38 per cent of the projected area of the roof. The coach shop has a skylight 22 feet 4 inches wide by 335 feet long, extending the full length of the building and also 32 separate skylights, making 33 per cent of the projected area of the roof.

In both the paint and coach shops at Angus there is a transverse skylight in the roof above each space between working tracks. There are 27 skylights in each shop and each skylight is 49 feet long by 12 feet wide.

ARRANGEMENT OF WORKING TRACKS.

The most satisfactory arrangement of working tracks for the repair and construction of passenger equipment seems to have been decided beyond question and is well exemplified by the large number of shops now in operation, both old and new. This provides for standing cars on transverse tracks, or working spaces, and as access by a system of ladder tracks would be uneconomical of ground space and as passenger equipment cannot be handled to advantage with traveling cranes, the transfer table is the most suitable means of access to the passenger car shop.

It does not seem possible to formulate a definite rule by which to determine the size of shop or number of working tracks in accordance with the number of cars owned by the road. In general it may be said that the

average working space required by each car standing in the shop is about 270 square feet. A consideration of the most likely examples of passenger car shops would lead to the conclusion that a suitable spacing for working tracks provides a distance of 20 feet between centers in the coach shop. At most places the same distance between tracks prevails in the paint as in the coach shop. However, at Collinwood on the Lake Shore & Michigan Southern Railway and at Burnside on the Illinois Central Railroad, the tracks in the paint shop are spaced 18 feet between centers while those in the coach shop are spaced on 20-foot centers. It is thought by some that a spacing of 18 feet in the paint shop is sufficient in all cases. At the Angus shops of the Canadian Pacific Railway and at the Readville shops of the New York, New Haven & Hartford Railway, the tracks in the coach shop are spaced 24 feet between centers. At the former this is probably due to the fact that the shop was planned largely for the construction of new cars and it was thought advisable to provide greater working space between tracks. At Readville the shop is unusually wide and the roof trusses are supported by columns located between the working tracks and the additional space is provided on this account. The length of the shop, then, is determined by the number of working tracks it is desired to provide.

A shop of such width as to house but a single car on each working track has the advantage of providing freedom of movement of each car in the shop as it is completed. On this basis many shops have been constructed to stand but one car per track. This practice does not prevail in all cases, however. The Burnside shop of the Illinois Central Railroad stands two cars on each working track and at Readville, on the New York, New Haven & Hartford, three cars are placed on each track. Such an arrangement requires greater care in the operation of the shop to prevent a finished car from being obstructed by others not so far advanced in the stages of repair.

TRANSFER TABLE SERVICE.

Arguments have been presented in favor of serving a passenger car shop with more than one transfer table, where each track has a standing capacity of two or more cars. Such an arrangement would remove the objection to the longer working tracks; but would have the disadvantage of taking up valuable space with the additional transfer table, besides the additional first cost of the table and the expense of maintenance.

At Topeka, on the Atchison, Topeka & Santa Fe Railway, the present coach and paint shops are served by two transfer tables and a new paint shop now under consideration is to be served by a third transfer table. Each working track stands but a single car and the present second transfer table is probably provided for delivery between the planing mill, storage yard and truck shop and the coach shop.

The length of the transfer table pit naturally depends upon the length of the shop, and the width of the pit is governed by the length of table necessary to accommodate the longest cars of the road. While the passenger car department of three prominent shops are served by tables operating in pits 80 feet in width, 75 feet seems ample for present day requirements and this width prevails at many recently constructed shops.

The distance from the transfer table pit to each shop varies materially and prevailing practice has not established a precedent in this particular. At some shops the distance on both sides of the pit are equal and at others there is a greater space on one side. At those shops at which the spaces between the transfer table pit and the buildings are unequal, the greater space is more often on the coach shop side. This condition does not prevail in all cases and no general practice seems to have been followed in this particular.

Unless sufficient space is provided to stand a car between the pit and one of the buildings, it would seem a waste of valuable ground to allow a greater space than that required for opening doors. It is now usual to provide for truck erecting and repair in a separate truck shop or on special tracks set aside for this work, so that the additional space between the pit and buildings is not required by truck repair work. If a space of this kind is provided and is not used it is apt to accumulate more or less scrap and junk or develop into a storage yard.

A space of one hundred feet on the paint shop side will allow for standing cars while being scrubbed and stripped and for storage while waiting to get into the shop. Where the coach shop stands three cars per working track, as at Readville, it permits clearing these tracks promptly without waiting for cars to be removed from the paint shop tracks.

At Angus, on the Canadian Pacific there is a space of 100 feet between the coach shop and the pit and this space is used for finishing cars as they are removed from the interior of the shop. Since being built this shop has been used principally for the construction of new cars, and the provision of this outdoor working space permits clearing the erecting tracks earlier and provides for a greater output by allowing work to be begun on a new car before the one formerly occupying the track has been entirely completed.

At the Southern Railway shops at Knoxville, Tenn., there is a space of 100 feet on each side of the transfer table pit, between the pit and the shop building. At the Long Island Railroad shops at Morris Park, there is a space 15 feet on each side of the pit.

OPERATION OF TRANSFER TABLE.

Electric power has been so generally adopted in railway shops that it is safe to say this is the only power considered for operating the transfer table, except, perhaps, at old shops where peculiar conditions will not permit. A single direct current motor of 50 horse power is capable of handling the heaviest car at a good speed. The speed of tables varies from a minimum speed of 100 feet per minute up to about 300 feet per minute when running light. The transfer table is usually equipped

with a winding drum by which cars are warped in and out of the shop.

Power is delivered to the table motors by various means. In some instances it is delivered by trolley wires carried on poles along one side of the pit; in others by wires suspended above the center of the pit, and sometimes the wires are secured to the stringers carrying the track rails.

FLOOR.

Floors of coach shops are of wood and of concrete. Floors of paint shops are usually of concrete and so sloped as to lead toward a gutter to drain the water dripping from cars while cleaning. The most suitable arrangement is a gutter running the full length of each space between tracks and covered with an iron grating. At Kingsland, on the D., L. & W., the coach shop has a level floor of concrete. The paint shop has a vitrified brick floor laid on concrete, the brick work being arched for drainage. The wooden floor absorbs moisture and has a tendency to keep the interior of the shop damp. It is said that on this account varnish will dry nearly a day quicker where the car is standing over a concrete floor than when the floor is of wood.

TRUCK REPAIRS.

While some shop plants provide a small shop building for the repair and erection of trucks, others provide two or more tracks at one end of the coach shop for this purpose. In the more prominent shops these tracks are served by hoists to facilitate the work and, while not always used, air hoists are considered very suitable. In the coach shop of the D., L. & W. at Kingsland, two tracks in one end of the building are reserved for truck work and are served by a 15-ton crane.

FIRE PROTECTION.

At several coach and paint shops the buildings are divided into sections by fire walls to prevent the rapid spread of flames in case of a conflagration. Such walls include doors wide enough to provide for trucking and other traffic and the opening is usually about 6 feet. These doors are usually kept open at all times, but have an automatic feature in their hanging that insures certain action in case of fire. They are hung on an inclined track and held open by means of counterweights which are released and allow the doors to close by gravity upon a rise of temperature sufficient to melt a fuse which controls the weights.

SCAFFOLDS.

There are many different types of scaffolds in use, as a number of prominent shops have worked out designs adapted to existing conditions. Adjustable scaffolds are now generally used and are far superior to the stationary scaffold or the old-time method of using trestles and plank.

PAINT MANUFACTURE.

The manufacture of paint is carried on more extensively by the Chicago & Northwestern Railway than by any other railway of which information is at hand. Deposits of ore occur near the line of the Chicago & Northwestern, so that the ore is obtained at a very reasonable cost. Ore is mined by the company, delivered to the paint manufacturing department of the company's shop at Chicago and the entire process of paint manufacture, from mining the ore to painting cars and locomotives, is conducted by the company.

Many other railway companies have paint mixing and grinding machines as part of the paint shop equipment; but it is not usual for paint manufacture to be carried on to any great extent by the railways.

PAINT SHOP AT MCKEES ROCKS—P. & L. E. R. R.

The paint shop of the Pittsburg & Lake Erie Railroad is constructed according to a design peculiar to itself and is different from the more common design of shop for the same class of work. Due to the shape of the ground on which the McKees Rocks shops are built, the paint shop is situated in an isolated location. It includes a number of interesting features with regard to both design and facilities provided.

The building is 204 feet long by 85 feet wide, inside, with a clear height of 19 feet 3 inches from floor to roof truss. The roof is supported between walls by three rows of steel columns, of five columns each, dividing the shop into six sections. The section at the south end, 34 feet wide, is partitioned off to provide accommodations for the washing and varnishing departments, office, etc. The partitions are built of concrete 3 inches thick, on expanded metal, all of which are covered up to the roof. Natural day lighting is provided by saw tooth skylights traversing the entire width of the floor and having northern exposure.

Convenience for the workmen is provided for by a suitable arrangement of lavatories and closets in one corner of the workroom. The closets are located on an elevated platform or balcony 9 feet above the floor and the wash basins are situated beneath.

There are four longitudinal tracks in the shop spaced on 20 foot centers and each track has a standing capacity of 2 cars. The tracks are provided with working pits of concrete construction and the floor of the shop is of concrete.

COACH AND PAINT SHOP AT PORTSMOUTH, S. A. L.

As representative of a shop which may be constructed rapidly and at small cost as well as one suitable for a mild climate the coach and paint shop of the Seaboard Air Line at Portsmouth, Va., is worthy of attention. This shop was built to replace the passenger car repair facilities which had been destroyed by fire and the work of construction was begun so soon after the debris from the fire had been cleared away that there was not time to prepare elaborate plans and the building was erected from rough pencil drawings.

The building is 330 feet long by 80 feet wide, containing 16 repair tracks, placed on 20 foot centers and served by a transfer table operating in a pit 330 feet long by 70 feet wide. The building is of brick construction to the height of the bottom of the windows above

which a wooden frame is covered by corrugated galvanized iron. Between the doors are high windows extending from the brick wall almost to the roof, providing ample light and their location is such as to distribute the light between the working tracks.

In the roof is a monitor extending the entire length of the building with side window lights. The flooring is of cement between the tracks, the cement extending to a jacking beam on each side of the track and flush with the flooring; the space between the rails is left open above the cross ties, except at the end of the tracks near the doors, which is boarded over for trucking material up and down the shop. Gutters are provided on each side of each track in such a position as to be immediately under the eaves of the car, and these gutters are so sloped as to drain towards the transfer table pit. The roof is covered with five-ply tar paper, over which is spread a coating of tar and pebbles. The doors through which cars are taken into the building are of the rolling steel type and at the back of the building there are double swing iron sheathed doors, 8 feet high through which trucks are rolled to the tracks extending about 25 feet beyond the building on which truck repair work is done.

In the east end of the building a section within the monitor is floored over, and constitutes a room in which upholstery work is done. This is connected by a stairway with the first floor and a small elevator for delivering material.

The building is heated by a direct steam system, pipe radiatiors being arranged longitudinally between the posts and beneath work benches, which are supported by the posts, the arrangement being such that a radiator is located between each track.

Lockers for the use of the workmen are arranged along the end and one side of the building, and these include a set which are numbered to correspond to the several working tracks, each large enough to hold the brass trimmings, lamps, etc., from one car.

No separate department has been provided for paint work and all varnishing, etc., is done within the coach repair and paint shop. The only provision made against dust, while cars are being painted, is the systematic location of the cars as they are brought into the shop; by this method two or three cars are standing between those on which repair work is being done and those which are being varnished.

In order to gain space, four tracks on the side of the transfer table opposite to the shop building are used for stripping and trimming coaches so that by the time they are brought into the shop they have been thoroughly stripped and cleaned, thereby keeping the objectionable and dirty work outside of the shop.

The coach repair and paint shop is connected with the mill building by a board walk to facilitate the delivery of material.

HEATING SYSTEM IN PAINT SHOP AT MIDDLETOWN, N. Y., N. Y. O. & W. RY.

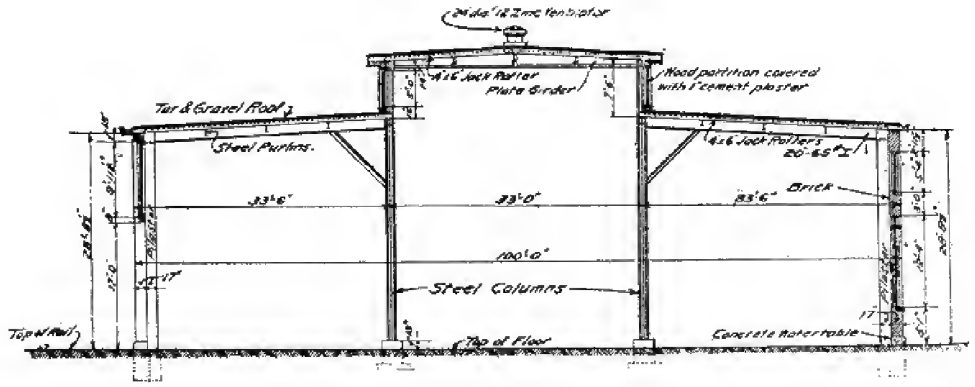
The arrangement of the delivery pipes of the heating system in the paint shop of the New York, Ontario & Western, at Middletown, N. Y., represents an innovation in paint shop heating. In more common arrangements of the blower system the air is distributed through overhead pipes extending across the roof and provided with long discharge pipes extending downward nearly to the floor. At Middletown the distributing pipes are carried beneath the floor.

The paint shop is a building with brick walls in which the roof structure is of wood and supported by two rows of wooden columns. The building as at present erected is 384 feet long, but designed for an addition of 80 feet. Its total width is 66 feet. There are three longitudinal working tracks arranged on 22 foot centers.

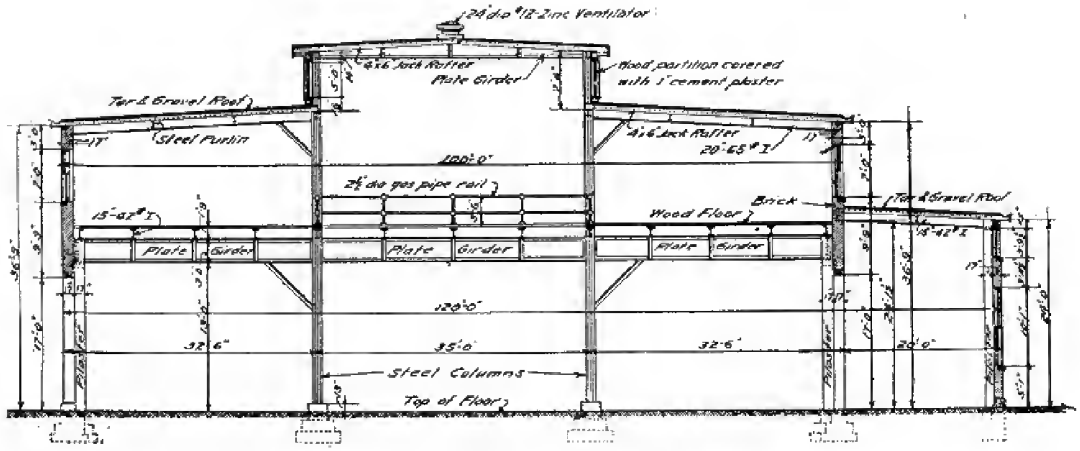
The heating equipment consists of an 8-foot fan wheel enclosed in steel plate casing connected with a casing of the same material containing the heater. In this heater are compactly arranged 10 sections containing 6,800 feet of 1-inch pipe, across which the air is drawn into the fan and thence discharged to the distributing system. The rapidity of air flow produced by the fan increases the efficiency of the heating surface from 300 to 500 per cent above that of the same area exposed in still air. A direct-connected 8 by 12-inch steam engine drives the fan up to a maximum speed of over 200 revolutions per minute, which is sufficient to insure a velocity of about 3,500 feet per minute through the discharge pipe. The heater is designed for the use of high pressure steam, and arranged so that the exhaust from the fan engine may be completely utilized.

The complete apparatus is placed in a small lean-to mid-length of the main building. Its central position reduces to a minimum the cost of the distributing system. Beneath the floor and alongside each of the walls and the column piers run four tile distributing pipes branching from the main brick cross duct from fan. Branches from these pipes lead to floor level, the upper portion of each being constructed of heavy galvanized iron, and so designed as to throw the escaping air at an angle to the floor. As a consequence, there is maintained at floor level a constantly changing volume of warm air which naturally ascends across the painted surfaces of the cars, thereby increasing the rate of drying. The constant replacement of the rising air by the incoming heated volumes insures a fresh warm atmosphere, which is particularly conducive to rapid drying.

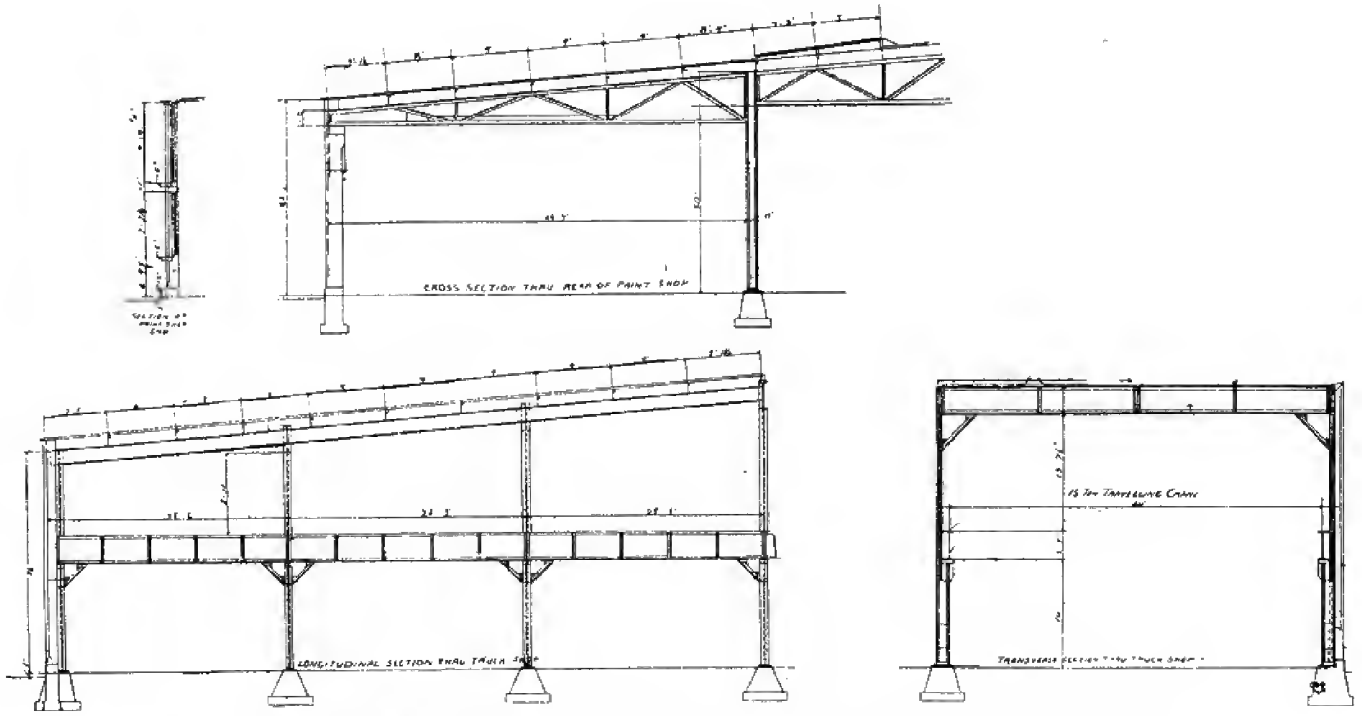
The outlets, which range from 6 inches to 8 inches in diameter, are spaced 16 feet apart so that practically perfect distribution and mixing is procured. Those in the middle of the building are protected from injury by the adjacent columns. The building is warm where warmth is desired—at the floor. The small rooms at the end of the building are heated by the same system through risers extending up from the underground ducts.



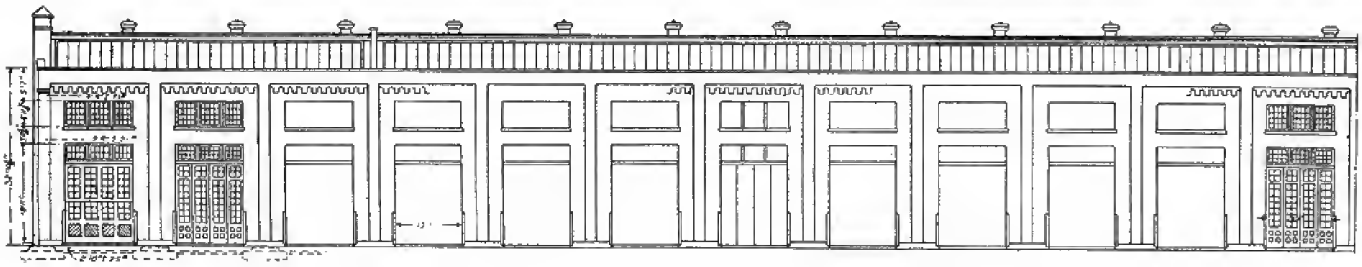
CROSS SECTION OF PAINT SHOP AT SEDALIA, MO., M. P. RY.



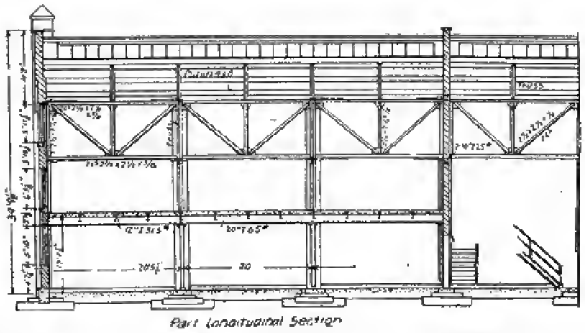
CROSS SECTION OF COACH SHOP AT SEDALIA, MO., M. P. RY.



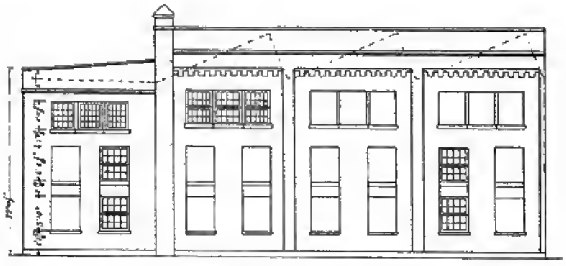
TYPICAL SECTIONS OF PASSENGER CAR SHOPS AT KINGSLAND, N. J., D., L. & W. R. R.



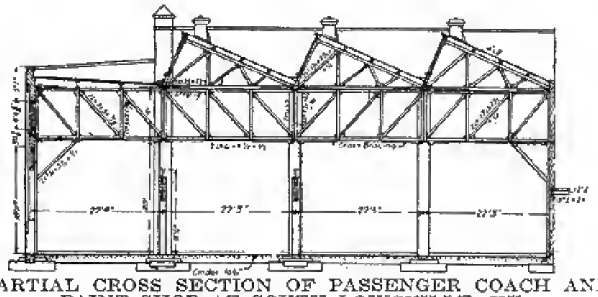
SIDE ELEVATION OF PASSENGER COACH AND PAINT SHOP AT SOUTH LOUISVILLE, KY., L. & N. R. R.



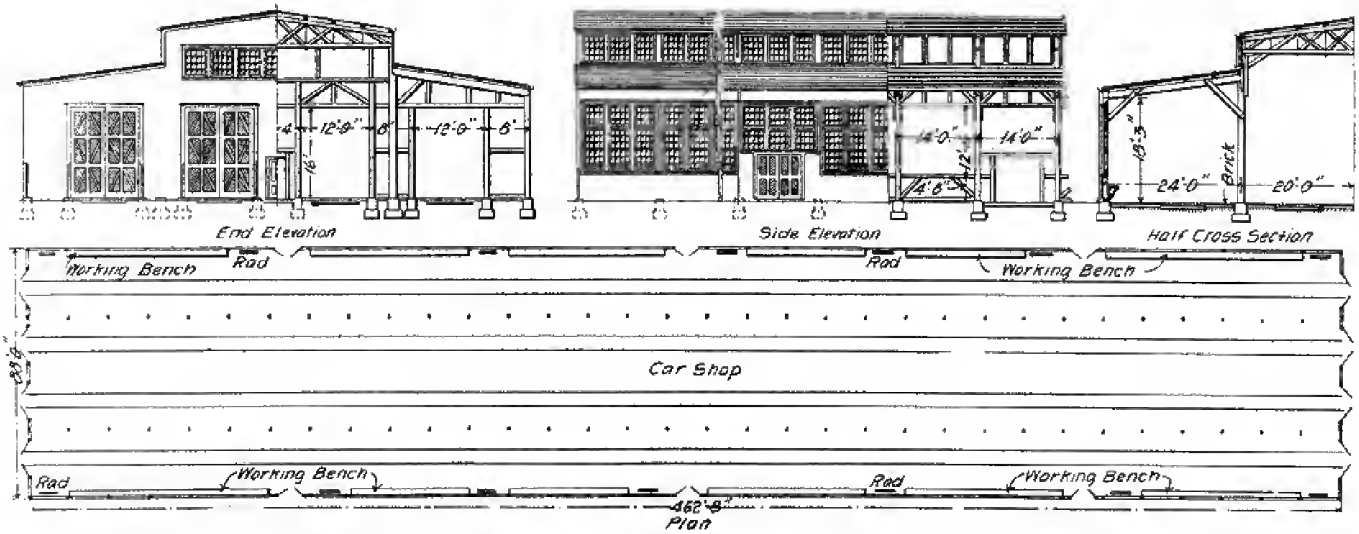
PARTIAL LONGITUDINAL SECTION OF PASSENGER COACH AND PAINT SHOP AT SOUTH LOUISVILLE, KY., L. & N. R. R.



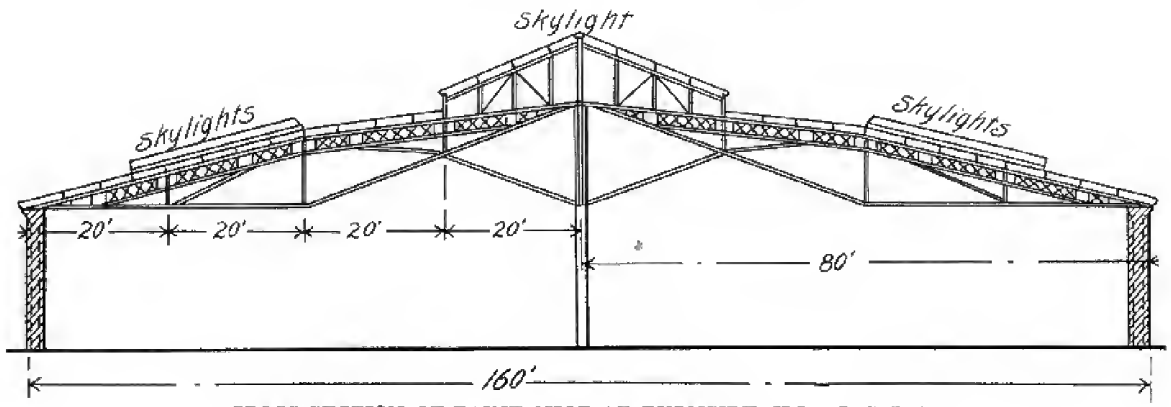
PARTIAL END ELEVATION OF PASSENGER COACH AND PAINT SHOP AT SOUTH LOUISVILLE, KY., L. & N. R. R.



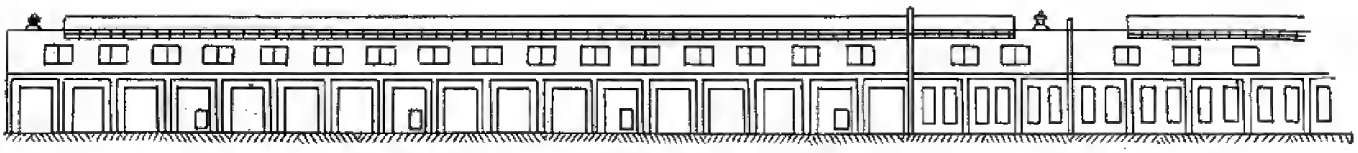
PARTIAL CROSS SECTION OF PASSENGER COACH AND PAINT SHOP AT SOUTH LOUISVILLE, KY., L. & N. R. R.



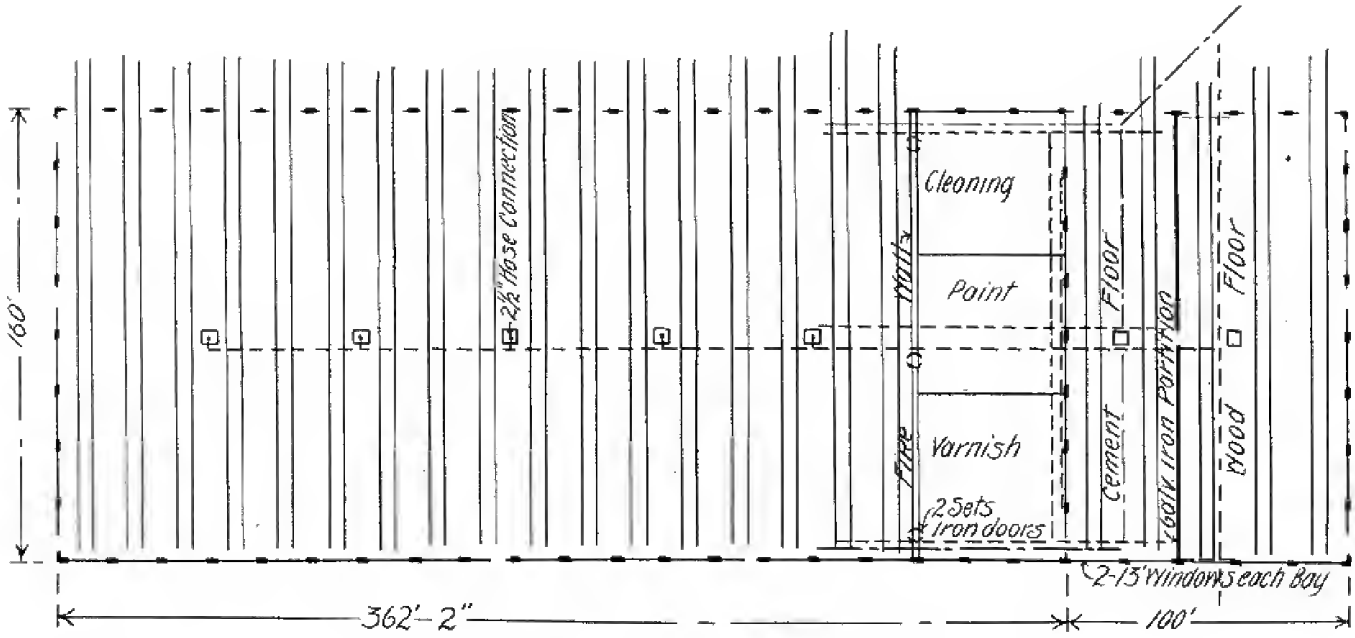
PLAN, ELEVATIONS AND SECTIONS OF PASSENGER COACH AND PAINT SHOP AT EAST DECATUR, ILL., WABASH R. R.



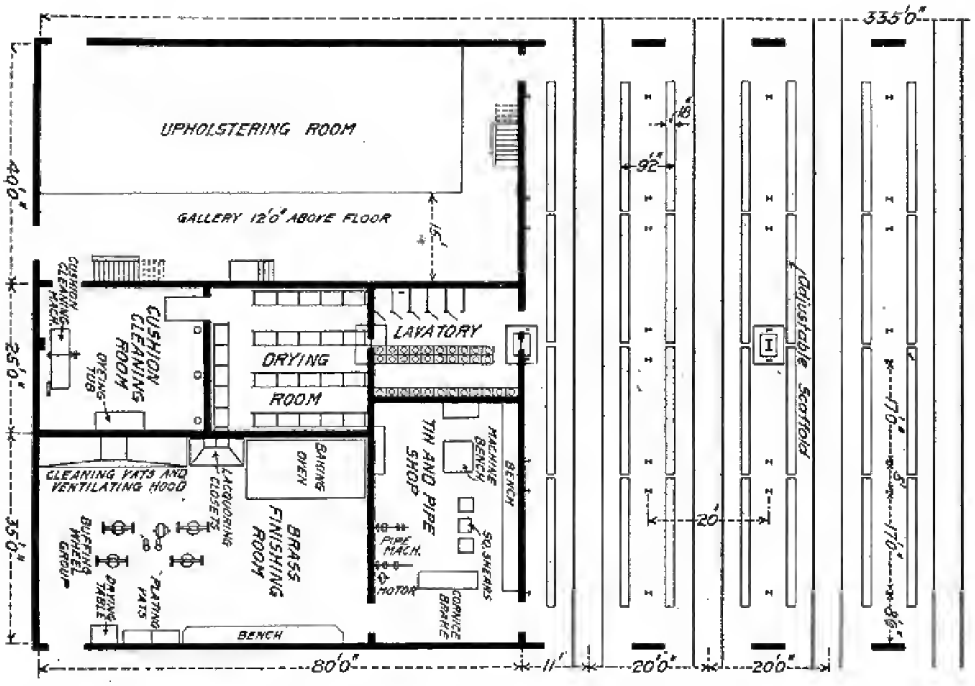
CROSS SECTION OF PAINT SHOP AT BURNSIDE, ILL., I. C. R. R.



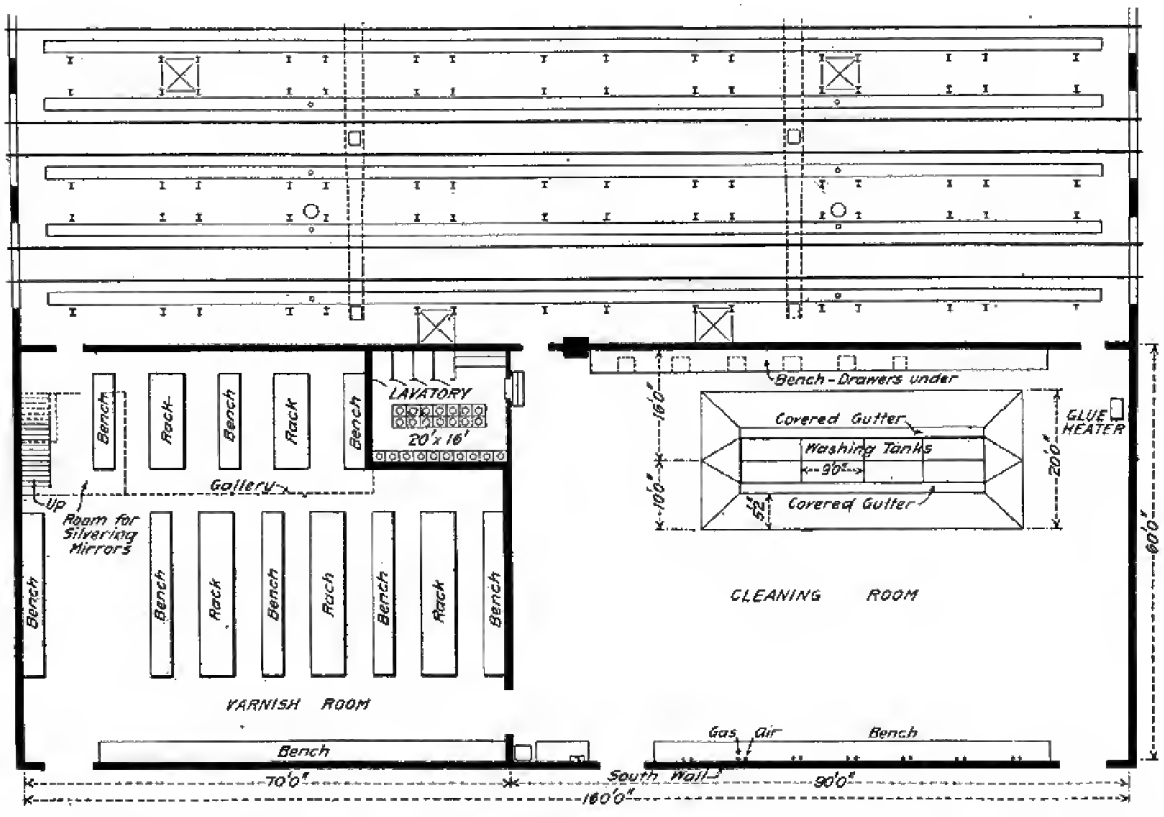
SIDE ELEVATION OF PAINT SHOP AT BURNSIDE, ILL., I. C. R. R.



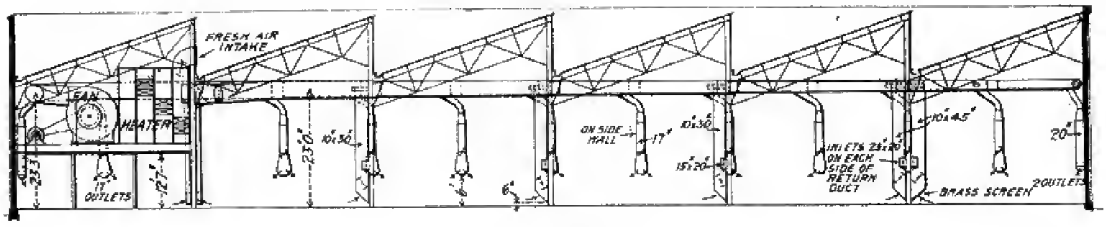
PLAN OF PAINT SHOP AT BURNSIDE, ILL., I. C. R. R.



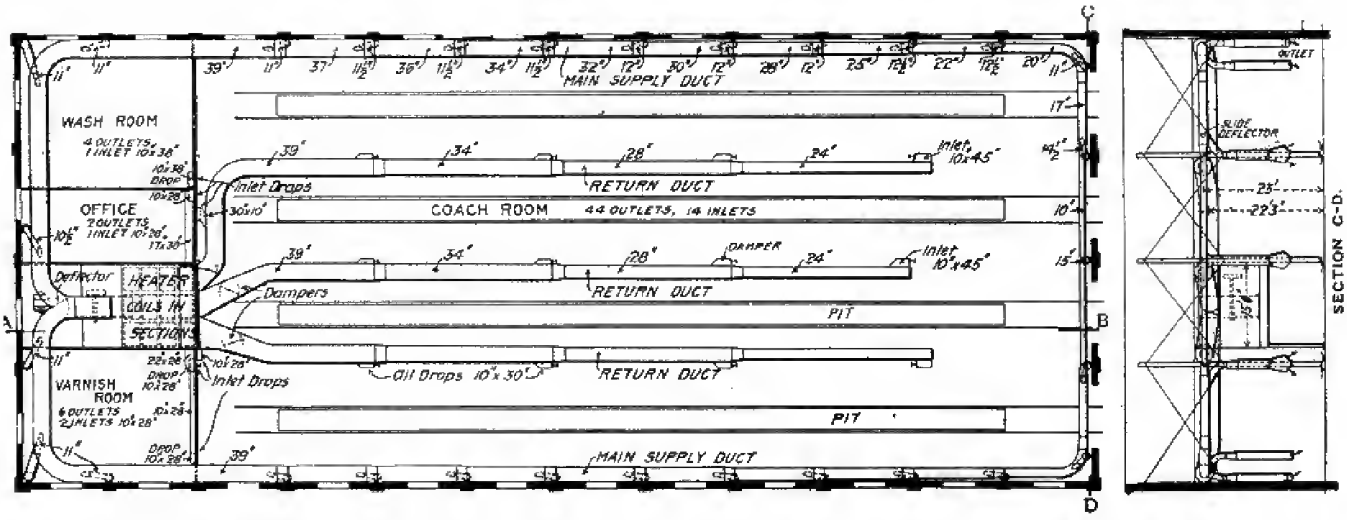
PARTIAL PLAN OF PASSENGER CAR REPAIR SHOP AT COLLINWOOD, OHIO, L. S. & M. S. RY.



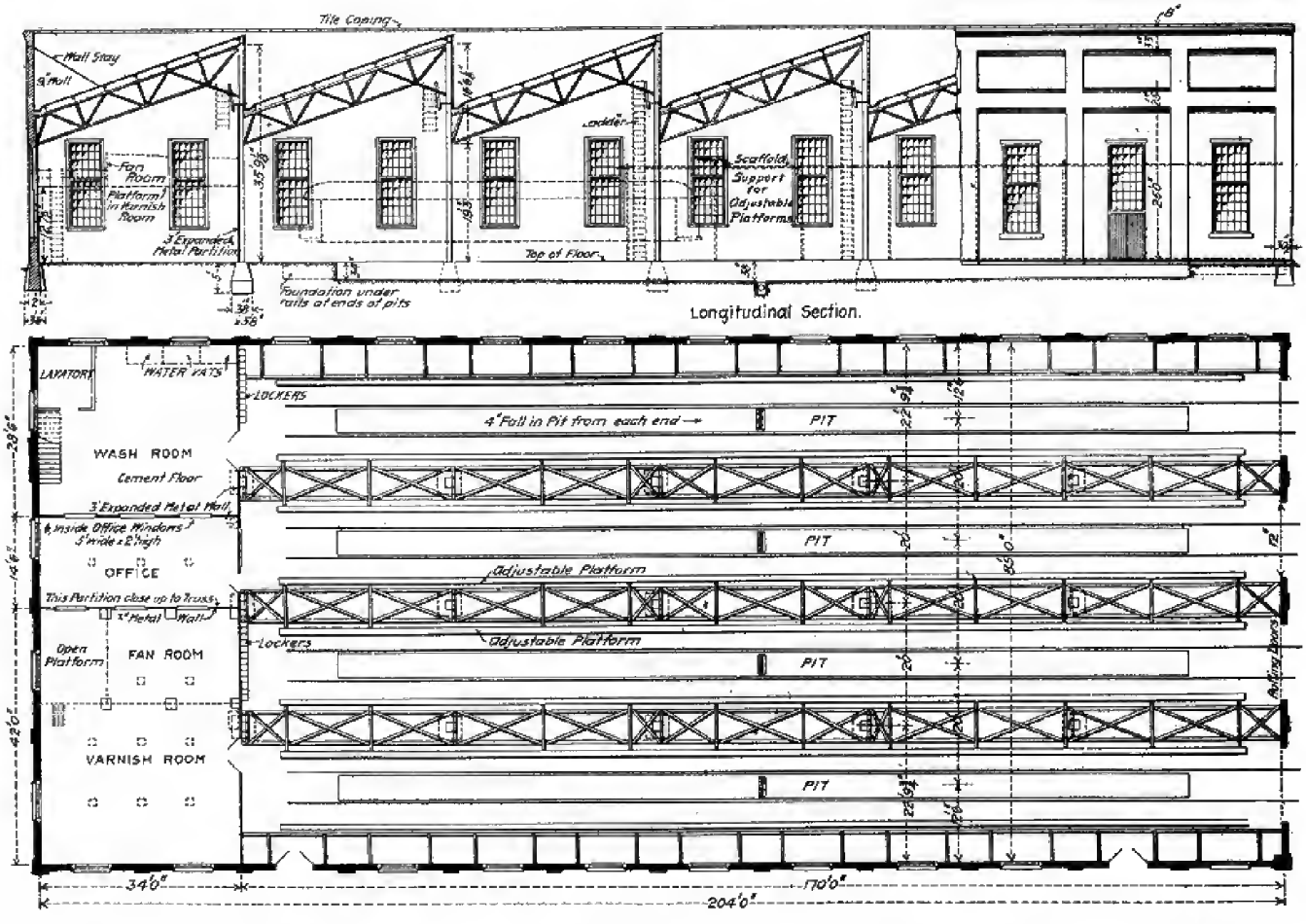
PARTIAL PLAN OF PASSENGER CAR PAINT SHOP AT COLLINWOOD, OHIO, L. S. & M. S. RY.



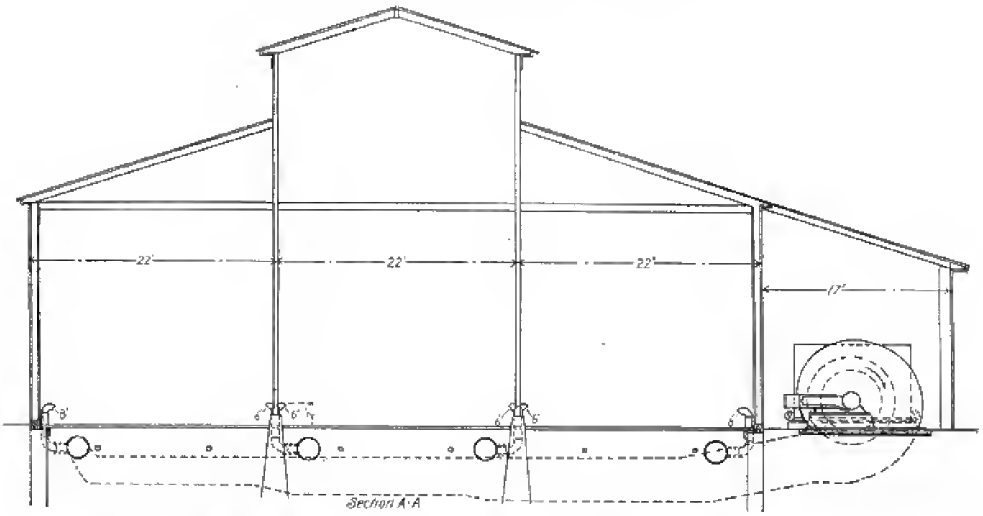
SECTION A-B.



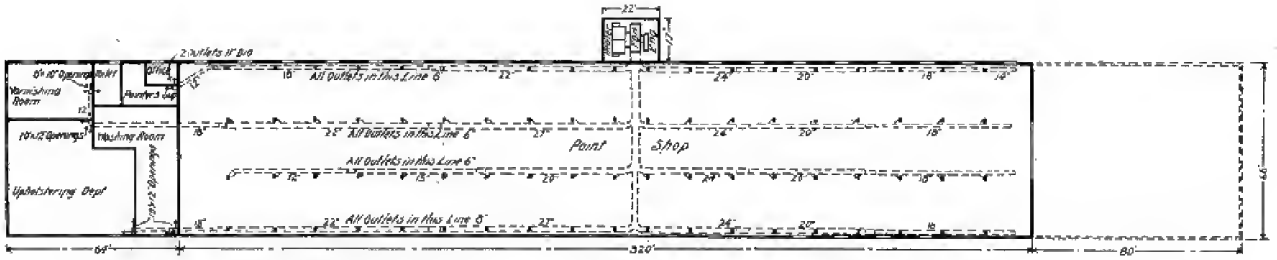
ARRANGEMENT OF HEATING SYSTEM IN PAINT SHOP AT McKEES ROCKS, PA., P. & L. E. R. R.



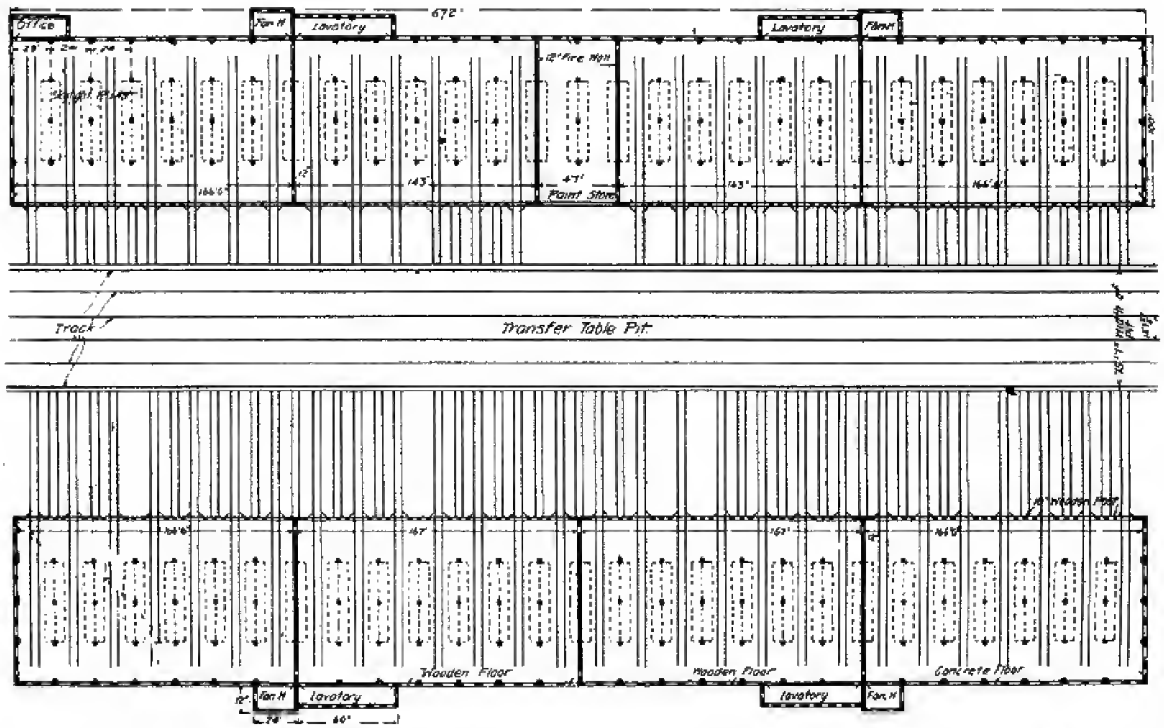
PLAN, PARTIAL SECTION AND ELEVATION OF PASSENGER CAR PAINT SHOP AT McKEES ROCKS, PA., P. & L. E. R. R.



CROSS SECTION OF PAINT SHOP, SHOWING LOCATION OF FAN, DISCHARGE PIPE, DISTRIBUTING PIPES AND OUTLETS AT MIDDLETOWN, N. Y., N. Y. O. & W. RY.



PLAN OF PAINT SHOP, SHOWING LOCATION OF DISTRIBUTING PIPES AND OUTLETS AT MIDDLETOWN, N. Y., N. Y. O. & W. RY.



TYPICAL ARRANGEMENT OF PASSENGER COACH AND PAINT SHOPS SERVED BY SINGLE TRANSFER TABLE—PLAN OF PASSENGER CAR SHOPS AT ANGUS, C. P. RY.

Railway Shop Up To Date

Chapter VIII

PLANING MILL

LOCATION.

THE planing mill is naturally located to provide facility in receiving stock in large bulk and for delivering it conveniently to the points of greatest consumption. As the lumber yard covers a large area it is placed at one end or side of the property, and as this supplies the planing mill, the mill building is usually at one side of the territory covered by the shop buildings. It is so situated as to give ready access to the rough lumber and pass stock through the various operations until the finished material is ready for delivering after passing in natural sequence over the shortest and most direct route.

The freight car shop consumes the greater portion of the output of the planing mill, so that the logical position for this building is between the lumber yard, dry lumber shed, dry kiln and the freight car shop. This provides a convenient arangement for ease in handling both rough and finished work. Where both freight car construction and repair work are carried on at the plant, the mill is the point of centralization of a large area and the rough material is directed toward this shop and delivered from it to each point of consumption for the different classes of work.

As the volume of material delivered to the passenger car department, either for construction or repair, is comparatively a very small per cent of that delivered to the freight car department, the location of the mill with regard to the passenger car department is of secondary importance. At the same time, however, the shorter the distance to this department and the more direct the route, the more economical will be the delivery of material and the greater the output of the department.

The planing mill also handles a certain amount of material for the locomotive department, for the engineering department, as well as for general repair work constantly arising from time to time. As there is, then, more or less general delivery to be provided for the mill building should be situated adjacent to the principal avenue of distribution and where this is a crane served runway, or midway as it is called, the mill is commonly placed contiguous to the midway.

BUILDING.

As in the case of most of the other principal buildings of the railroad shop plant a long narrow building lends itself most readily to the requirements of the planing mill. In view of the varying conditions governing the demands upon the planing mill—whether providing for construction or repair, the consumption of lumber by departments other than the car departments—there is not sufficient similarity in the size of the mill buildings of the many shops throughout the country to justify an attempt to formulate a rule determining the size of the floor area in proportion to any given unit, such as working space per locomotive, freight car or passenger car, number of freight cars per day, or passenger cars turned out per month.

At the Angus shops of the Canadian Pacific, including locomotive, freight car construction and passenger car departments, the dimensions of the mill are 500 feet by 125 feet, providing an area of 62,500 square feet. At Collinwood, on the L. S. & M. S. where locomotive, freight car repair, freight car construction and passenger car repair are carried on, the mill is 300 feet by 70 feet, giving an area of 21,000 square feet. At Readville, where the plant is devoted entirely to freight and passenger car work, the mill is 350 feet by 125 feet, an area of 43,750 square feet. At the D., L. & W. freight car building and repair shops at Scranton, the mill is 400 feet by 90 feet, providing an area of 36,000 square feet. At the East Decatur car shops of the Wabash the mill is 238 feet by 80 feet, an area of 19,040 square feet.

The floor area of the mill is necessarily large in proportion to the area covered by the machine equipment. The large volume of material passing through the mill, as well as its nature, size and shape, requires ample space for its disposition and movement and a large proportion of the stock uses temporary standing space both before and after passing each machine through which it travels.

The construction of the mill is in many respects similar to the other buildings of the car department. The roof trusses, supporting columns, etc., are of the same material and either wood or steel has been used in some of the most prominent shops recently constructed.

In the earlier and older shop buildings the roof structure was designed for greater stiffness than now required, to provide for the additional loads and the vibrations of shafts, pulleys, belts, etc. Power for the mill was usually delivered from an engine in an adjoining building, and all shafts, etc., were carried by the roof structure. The introduction of electrical apparatus and equipment has largely changed this and prevailing practice is to drive the larger machines by individual motors and the smaller machines in groups. The motors are usually placed upon the floor close to the machines, though the motors for group drive and for the smaller machines are sometimes suspended from the roof trusses.

NATURAL LIGHTING.

In mill buildings of the most recently constructed shops a noticeable feature is the provision for ample natural lighting. In some of them the space occupied by windows begins a short distance above the ground and extends as close to the roof as the limits of the wall will

allow. Light from windows in the wall is supplemented by skylights in the roof. At Collinwood the skylight is 260 feet long by 36 feet 6 inches wide and provides an area equal to 45 per cent of the area of the roof. At Angus there are 23 skylights in the roof, arranged transversely, and each skylight is 29 feet by 10 feet 4 inches in size. The absence of belts, shafts, pulleys, etc., in a planing mill adds materially to the efficient distribution of light and freedom from shadows.

DISTRIBUTION OF MATERIAL.

Convenience in the distribution of material necessitates its entrance at the end of the mill adjacent to the lumber yard and delivery at the other end. This requires large doors in the ends of the building and delivery tracks extending the full length of the building. Larger planing mills are equipped with two tracks traversing the building and the spaces which they occupy are kept open for the movement of light wagons or buggies, as well as for the transportation of push cars. In accord with the general sentiment in favor of standard gauge industrial tracks for delivery and distribution of material, the tracks through the mill are more commonly of standard gauge.

In the mill building at Kingsland, on the D., L. & W., there is a third rail between the rails of the standard gauge track, making a narrow gauge track for connection with the narrow gauge industrial system of the plant. Two other narrow-gauge tracks in the mill connect with the general industrial system of tracks. At the Scranton shops of the same road, the mill is served by narrow gauge industrial tracks, as well as being entered by a standard gauge track from the lumber yard.

Serving the mill building by tracks of standard gauge provides the advantage of allowing cars of lumber to be switched into the building and unloaded near the machines, thus reducing the cost of handling and removing the additional expense of unloading and stacking in the yard. Such a method is not practical at all times, but some shops make a practice of delivering a certain amount of material on order, direct to the mill and unloading it at night where it will be ready for the regular shop force in the morning.

The shop tracks are sometimes supplemented by short stub tracks immediately outside of the building for temporarily storing truck loads of lumber. A convenient and practical arrangement for the delivery of truck loads of material both to and from the planing mill is the provision of a small hand transfer table, operating in a shallow pit, at each end of the building. This method is followed to good advantage at Angus and the transfer tables permit convenient access to the several tracks of the lumber yard, mill building, car erecting shop or general delivery.

The use of side doors in the wall of the building near the dry kiln or dry lumber storage shed facilitates the rapid delivery of material. Such a method permits material to follow the most direct route from the point of storage to the machines through which it will pass. Not only is this delivery quicker, but it relieves congestion around the end doors where sills and other heavy material enter the building.

FLOORS.

Wooden floors prevail generally in the planing mill.

ARRANGEMENT OF MACHINES.

Among the most important features of the planing mill is the arrangement and distribution of machines to provide for the progressive movement of material in natural sequence and to provide for handling bulky and heavy pieces of stock, as well as a large volume of small material. There are many very interesting examples illustrating great care in the layout of machines so that the work will progress, naturally avoiding the necessity of moving timber backward in its course.

The layout of machines is usually such that those for machining sills occupy a large portion of one side of the mill, while the remaining large portion is occupied by the various machines used in light lumber dressing. The arrangement of machines in sequence in that section through which the heavier material passes is naturally of greater importance than in the section for lighter material. The arrangement of the tools in the paths of progress are such as to bring the material to the roughing machines first, through the supplemental machines and finally to those for finishing.

In both sections, the most satisfactory arrangement provides for the movement of material in such manner that it will touch the floor as little as possible. For instance, in the path of sills are placed wooden skids of about the same height as the machine tables, so disposed that the sills may be moved longitudinally or transversely according as the machines are situated in its path, but always the general movement is forward.

The systematic arrangement of skids in the path of other material is more difficult than in the case of the sills. However, it is often possible to arrange such paths over short distances and for certain classes of work. Where this cannot be done, the most economical method is to deliver small material to each machine in wagon loads and load it directly upon a wagon on the other side of the machine. In the rapid handling of material much work is done to templates, thereby minimizing the labor of laying out.

The planing mill at Angus is operated in two distinct departments, one of which is under the jurisdiction of the foreman of the freight car erecting shop and is used for dressing freight car material only. The other section is under the jurisdiction of the passenger car foreman and serves his department only. The machines in both departments are arranged largely in straight lines and every facility is provided for the rapid movement of lumber with minimum amount of handling.

SHAVINGS EXHAUST SYSTEM.

An essential feature of the planing mill is the collector system for disposing of shavings, dust, etc. This system

is connected with the boiler room where one or more boilers of the power plant are fed by shavings and chips from the mill. Exhaust blowers are located at convenient positions within the building and from them suction pipes lead to hoods covering the cutters or saws of the various machines, so as to draw in instantly all chips and shavings produced by the cutting tools. Floor sweep openings are provided at those machines which can not be served to advantage by hoods over the cutters and at various places to accumulate sweepings from the floor. Everything that may be consistently raked or swept to these openings will be drawn away quickly by the suction. The collector system is usually so effectual that it will readily remove rather large sticks and blocks. The result of this system is that the planing mill may be kept in a very neat and clean condition at a comparatively small expense while the delivery of refuse to the boiler room is at a nominal cost.

The shavings exhaust system at Angus employs 17 fans from 50 to 90 inches in diameter, and running from 665 to 1,700 revolutions per minute, the maximum speeds of the fans in the planing mill being 880 feet per minute. The longest run of conduit in this system is 700 feet. In deciding upon the capacity for the equipment computations were made upon the difference between finished and rough dimensions of timber in a 30-ton box car. This amounts to 860 feet board measure, or 72½ cubic feet per car, and this volume will fill two or three times that space when put into the form of shavings and sawdust.

List of Wood-Working Machinery in Representative Railway Shops—Planing Mill

CANADIAN PACIFIC—ANGUS.

	Machine.	Size.	Maker.
2	Planers and sizers	No. 8	Berlin Machine Co.
	Inside moulder	No. 125	Berlin Machine Co.
2	Self feed rip saws	No. 3	Greenlee Bros & Co.
	Self feed rip saw	No. 3	Greenlee Bros. & Co.
	Vertical heavy automatic cut-off saw	No. 5	Greenlee Bros. & Co.
	Heavy vertical cutoff saw	No. 5	
	Extra range automatic car gaining machine		Greenlee Bros. & Co.
2	Horizontal tenoners	No. 5	Greenlee Bros. & Co.
	Special automatic vertical car sill tenoning machine	No. 4	
	Vertical boring machine	4-spindle	Greenlee Bros. & Co.
	Extra range heavy car boring machine		Greenlee Bros. & Co.
	Heavy vertical boring machine	5-spindle	Greenlee Bros. & Co.
	Extra car range boring machine		Greenlee Bros. & Co.
	Vertical boring machine	3-spindle	Greenlee Bros. & Co.
	Standard heavy vertical car boring machine	3-spindle	Greenlee Bros. & Co.
	Boring machine	3-spindle	Greenlee Bros. & Co.
	Heavy single spindle radial horizontal borer		Greenlee Bros. & Co.
2	Standard heavy vertical hollow chisel mortisers		Greenlee Bros. & Co.
	H. C. mortising machine	No. 14	Greenlee Bros. & Co.
3	Self feed rip saws	No. 1½	Greenlee Bros. & Co.
	Large car ripping saw	No. 3	Fay & Egan Co.
2	Improved rip saws	No. 2	Fay & Egan Co.
	Band saw		Fay & Egan Co.
	Band saw	No. 00	Fay & Egan Co.
	Car mortiser and borer	No. 72	Fay & Egan Co.
4	Automatic cutoff saws	No. 1	Greenlee Bros. & Co.
	Automatic cutoff saw	No. 2	Greenlee Bros. & Co.
2	Planers and matchers	No. 46	Berlin Machine Co.
	Planer and matcher	No. 44	Berlin Machine Co.
	Band saw	No. 3	MacGregor-Gourlay Co.
	Automatic vertical cutoff saw		Fay & Egan Co.
	Vertical automatic cutoff saw and gainer	No. 3	Greenlee Bros. & Co.
	Vertical heavy automatic cut-off saw	No. 6	Greenlee Bros. & Co.
	Vertical boring machine	3-spindle	Greenlee Bros. & Co.
	Medium heavy boring machine	3-spindle	Greenlee Bros. & Co.
	Perfection buzz planer	20-ins.	MacGregor-Gourlay Co.
	Shaping machine		MacGregor-Gourlay Co.
	Dimension saw		MacGregor-Gourlay Co.
	Outside moulding		MacGregor-Gourlay Co.
	Small rip saw		MacGregor-Gourlay Co.
	Rip saw		MacGregor-Gourlay Co.
	Improved rip saw		MacGregor-Gourlay Co.
	Large band saw		MacGregor-Gourlay Co.
	Self feed rip saw		MacGregor-Gourlay Co.
	Chain saw mortiser		
	Band saw		MacGregor-Gourlay Co.
	Burring saw		J. Bertram & Sons
	Large rip saw		J. Bertram & Sons
	Small rip saw		Cowan & Co.
	Swing saw		MacGregor-Gourlay Co.
	Swing saw		
	Dimension planer		Fay & Egan Co.
	Buzz planer		MacGregor-Gourlay Co.
	Surface planer	No. W 14	J. Bertram & Sons
	Dimension planer		MacGregor-Gourlay Co.
	Large matcher and dimension planer	4-headed	J. Bertram & Sons
	Matcher and dimension planer	4-headed	Cant-Gourlay
	Sticker	4-headed	MacGregor-Gourlay Co.
	H. C. mortiser		Atlantic
	Small sash and door mortiser		

	Machine.	Size.	Maker.
	C. mortiser		Atlantic
	Vertical boring machine	3-spindle	Fay & Egan Co.
	Single horizontal borer		
	Vertical gainer		Fay & Egan Co.
	Horizontal gainer		J. Bertram & Sons
	Large matcher	4-headed	Fay & Egan Co.
	Large horizontal tenoner		
	Light tenoning machine		McKechnie & Bertram
	Double headed shaper		MacGregor-Gourlay Co.
	Vertical end tenoning machine		McKechnie & Bertram
	Sticker	4-headed	MacGregor-Gourlay Co.
	H. C. mortiser		Greenlee Bros. & Co.
	Boring machine	5-spindle	Greenlee Bros. & Co.
2	Iron frame swing saws		
	Boring machine	3-spindle	
	Horizontal gainer		Fay & Egan Co.
	Boring machine	6-spindle	Greenlee Bros. & Co.
	Self feed saw		Greenlee Bros. & Co.
	Variety wood-worker	No. 2	Fay & Egan Co.
	P. H. shaper		MacGregor-Gourlay Co.
	Horizontal tenoner		Buck
	Car tenoner	No. 5	Fay & Egan Co.
2	Horizontal gainers		J. Bertram & Sons
	Planer and matcher	No. 24	Berlin Machine Co.
	Single horizontal boring machine		
	Vertical car sill tenoning machine		
	Gainer and checker		
	Rip saw		
2	Swing saws		
	Iron frame swing saw		

D., L. & W.—SCRANTON (KEYSER VALLEY).

Machine.	Size.	Maker.
Double planer and matcher		Berry & Orton Co.
Swing saw	30 ins.	D. L. & W. R. R.
Rip saw	up to 24 ins.	D. L. & W. R. R.
Double planer and matcher	No. 17	S. A. Woods Machine Co.
Outside moulder	6 ins.	C. B. Rogers & Co.
Cross-cut saw	40 ins.	No. 188, S. A. Woods Machine Co.
Sill tenoner	No. 0	C. B. Rogers & Co.
Cross boring machine	No. 350	S. A. Woods Machine Co.
Boring machine, 4 spindles	No. 325	S. A. Woods Machine Co.
Vertical car boring machine	3 spindles	C. B. Rogers & Co.
Rip saw		D. L. & W. R. R.
Automatic cross-cut saw	36 ins.	No. 3, Fay & Egan Co.
Rip saw	24 ins.	No. 175, S. A. Woods Machine Co.
Sticker	5-head	Housten
Upright shaping machine	No. 0	C. B. Rogers & Co.
Matcher		Fay & Egan Co.
Gaining machine		S. A. Woods Machine Co.
Gaining machine (pneumatic)		D. L. & W. R. R.
Hollow chisel, hollow mortiser	No. 7	S. A. Woods Machine Co.
3-spindle boring machine		Berry & Orton Co.
2 Wood turning lathes		
Saw grinding and sharpening machine	No. 231	S. A. Woods Machine Co.
Automatic knife grinder	No. 221	S. A. Woods Machine Co.
Band saw filer		Chas. E. Wright
Band saw	36 ins.	No. 3, C. B. Rogers & Co.
Swing saw	22 ins.	No. 232, S. A. Woods Machine Co.
Hand planer		C. B. Rogers & Co.
Door and sash tenoning machine	No. 3½	Fay & Egan Co.
Extra heavy sizer	6-roll, 4 sides	Fay & Egan Co.
Flooring machine, fast speed	No. 17	No. 111, Fay & Egan Co.
Double cutting-off machine	40 ins.	No. 5, Greenlee Bros. & Co.
Vertical car boring machine, 4 spindles		Greenlee Bros. & Co.

Vertical car boring machine, 4 spindles, with universal attachment		Greenlee Bros. & Co.
Heavy self-feed saw	No. 3	Fay & Egan Co.
Combination vertical borer and gainer	No. 3	Greenlee Bros. & Co.
Small vertical hollow chisel mortiser	No. 11	Greenlee Bros. & Co.
Hollow chisel mortiser	No. 8	Greenlee Bros. & Co.
Vertical car tenoning machine	No. 4	Greenlee Bros. & Co.
Double tenoning machine	No. 540	Greenlee Bros. & Co.
Car brace cutting-off machine		Greenlee Bros & Co.
Cross-cut saw		D. L. & W. R. R.
Wood turning lathe		
Cut-off saw	22 ins. No. 2	Fay & Egan Co.
Groove saw	12 ins	
Box bound matcher		
Grindstone		
Heavy combined buzz planer	No. 97	S. A. Woods Machine Co.
Hollow chisel sharpener		Atlantic
Band resawing machine		American Wood Wkg. Mach. Co.
Sharpener for circular saw		Atlantic
Band saw filing and setting machine		Atlantic
Lathe		
Rip saw		S. A. Woods Machine Co.
Jig saw		
Single surfacer	No. 88	S. A. Woods Machine Co.
Band saw		C. B. Rogers & Co.
Emery grinder and dust guard machine		
Mortiser		R. Ball & Co.
Shaper		H. D. Stovers
Knife grinder		

L. S. & M. S. RY.—COLLINWOOD.

Machine.	Size	Maker	Motor H. P.
Timber planer	Four-side	Fay & Egan	35
Timber planer	Four-side	Amn. W. W. Mach. Co.	35
"Lightning" matcher		Fay & Egan Co.	25
Matcher	No. 27	S. A. Woods Mach. Co.	35
Automatic cut-off saw	No. 6	Greenlee Bros. & Co.	20
Vertical end tenoner	No. 4	Greenlee Bros. & Co.	15
Rip saw	No. 4	S. A. Woods Mach. Co.	20
Cut-off saw, automatic	No. 4	Greenlee Bros. & Co.	15
Vertical saw and gainer	No. 8	Fay & Egan Co.	20
Automatic cut-off saw	No. 3	Greenlee Bros. & Co.	15
Rip saw	No. 3	Greenlee Bros. & Co.	20
Automatic saw and dado		Greenlee Bros. & Co.	15
Bevel band saw	40 ins.	Williamsport Mach. Co.	10
Band saw	42 ins.	Fay & Egan Co.	7½
Horizontal mortiser	H. C.	Fay & Egan Co.	15
Vertical mortiser and borer	No. 7	Greenlee Bros. & Co.	15
Gainer	No. 3	Fay & Egan Co.	15
Tenoner	No. 70	Fay & Egan Co.	7½
Horiz. boring machine	Four-spin	Greenlee Bros. & Co.	10
Jointer		Fay & Egan Co.	7½
Pony planer	24 ins.	S. A. Woods Mach. Co.	10
Gainer with 4-spindle borer	No. 3	Greenless Bros. & Co.	10&15
Shaper	Double head.	Grosvenor	7½
Automatic saw filer			7½
Automatic knife grinder			7½
Automatic saw grinder			7½
Band Saw Filer			7½
Wood lathe		Fay & Egan Co.	7½

L. & N. R. R.—SOUTH LOUISVILLE.

Machine.	Size.	Maker.	Motor H. P.
Short sill dresser	20-in. blade.	S. A. Woods Mach. Co.	100
Cut-off saw	40-in.	Greenlee Bros. & Co.	15
Cut-off saw	40-in.	Greenlee Bros. & Co.	15
Matcher	15-in. blade.	Fay & Egan Co.	30
Matcher	10¼-in. bl'de	Fay & Egan Co.	50
Matcher	10¼-in. bl'de	Fay & Egan Co.	30
Cut-off saw	34-in.	Fay & Egan Co.	8
Cut-off saw	34-in.	Fay & Egan Co.	14
Cut-off saw	32-in.	Fay & Egan Co.	30
Surfacer	26-in. blade.	Fay & Egan Co.	30
Heavy rip saw	28-in.	No. 153 S. A. Woods Machine Co.	30
Light rip saw	28-in.	Greenlee Bros. & Co.	30
Borer	5 spindle	Greenlee Bros. & Co.	30
Vertical hollow chisel mortiser with traveling table	No. 154	Fay & Egan Co.	30
Sill tenoner	3 cutters	Fay & Egan Co.	30
Gainer		Greenlee Bros. & Co.	14
Swing cut-off saw	24 in.	L. & N. R. R.	5
Borer	5 spindle	Fay & Egan Co.	18
Vertical hollow chisel mortiser with traveling table	No. 154	Fay & Egan Co.	18
Automatic car gainer	No. 150	Fay & Egan Co.	18
Universal car tenoner		Fay & Egan Co.	50
Horizontal borer		Fay & Egan Co.	50
Vertical single spindle borer		Bentel & Margedant	50
Band saw	No. 2	Fay & Egan Co.	50
Dimension planer	24 in. blade.	Fay & Egan Co.	50
Universal wood-worker		Fay & Egan Co.	8

M. P. RY.—SEDALIA.

Machine.	Size.	Maker.
Universal wood worker	16-in.	Greenlee Bros. & Co.
Variety wood worker	No. 62	Fay & Egan Co.
Four-side moulder	No. 12	Fay & Egan Co.
Surfacer	30-in.	S. A. Woods Machine Co.
Six-roll cylinder planer	No. 129	Fay & Egan Co.
Vertical car tenoner		Fay & Egan Co.
Tenoning machine	No. 6	Fay & Egan Co.
Car gaining machine		Fay & Egan Co.
Hand gaining machine		Fay & Egan Co.
Mortiser		Greenlee Bros. & Co.
Mortiser	No. 300	S. A. Woods Machine Co.
Four-spindle horizontal boring machine		Greenlee Bros. & Co.
Cut-off saw	No. 3	Fay & Egan Co.
Cut-off saw	No. 2	Fay & Egan Co.
Swing saw	No. 3	Fay & Egan Co.
Self-fed rip saw	No. 3	Fay & Egan Co.
Band saw	No. 1	Fay & Egan Co.
Band saw	No. 3	Fay & Egan Co.
Scroll saw	No. 3	Fay & Egan Co.
Automatic saw sharpener		
Band saw setter	No. 3	Fay & Egan Co.
Knife grinder		Fay & Egan Co.
Fox trimmer		
Superior setting down machine		
Raymond wiring machine		
Raymond large turning machine		
Raymond small turning machine		
Groover	20-in.	Buffalo
Double seamer		Moore
Beader	No. 2	Niagara

List of Wood-working Machinery in Representative Railway Shops—Cabinet Shop.

CANADIAN PACIFIC RAILWAY—ANGUS.

Machine.	Size.	Maker.	Motor H. P.
Double combination glue spreader			2
Window blind mortiser		J. Bertram & Sons	5
Window blind slot mortiser		McGregor, Gourley & Co.	5
Boults carver		McGregor, Gourley & Co.	5
Royal invincible sander		Berlin Machine Works	40
Jig saw		C. P. R.	7½
Sash and door mortiser		J. Bertram & Sons	7½
Band saw	No. 3	McGregor, Gourley & Co.	7½
Double tenoning machine	6 in.	McGregor, Gourley & Co.	15
Chain mortiser	No. 66	New Britain Mach. Works.	5
Sash sticker		McGregor, Gourley & Co.	5
Finishing saw, mitering work		Herbert Baker & Co.	10
Band saw	36 in. wheel	McGregor, Gourley & Co.	10
Inside moulder	4-headed	McKechnie & Bertram	20
Pony planer		Fay & Egan Co.	20
Grindstone	72-in.	Niles-Bement-Pond Co.	20
Emery wheel		C. P. R.	20
Dimension saw table	16 ins. wide, 3 ins. thick	McGregor, Gourley & Co.	20
Saw, double-headed	16 ins.	McGregor, Gourley & Co.	20
Perfection buzz planer and jointer		McGregor, Gourley & Co.	20
Dimension planer, sizing and straightening		McGregor, Gourley & Co.	15
Swing saw	16-in. ¼ to 1 1-12	C. P. R.	5
Feed rod machine	In.	McGregor, Gourley & Co.	5
Wood lathe	24-in.	McGregor, Gourley & Co.	5
Wood lathe	20-in.	Smith & Coventry	5
Swing saw	16-in.	C. P. R.	5
Universal Woodworker		Fay & Egan Co.	15
Rip saw	12-in.	McGregor, Gourley & Co.	15
Panel planer		McGregor, Gourley & Co.	20
Tenoning machine		McGregor, Gourley & Co.	20
Rip and cross cut saw	14-in.	McGregor, Gourley & Co.	20
Inside moulder	3 sided	McGregor, Gourley & Co.	15
Chain mortiser	No. 66	New Britain Mach. Works.	15
Chain grinder		New Britain Mach. Works.	15
Shaping machine		McGregor, Gourley & Co.	10
Shaping machine		McGregor, Gourley & Co.	10
Boring machine	Single spindle	McGregor, Gourley & Co.	10
Friezing machine		Fay & Egan Co.	10
Carver	2-spindle	Blouts	10

L. S. & M. S. RY.—COLLINWOOD.

Machine.	Size.	Maker.
Sticker		American Wood Working Mach Co.
Jointer		Clement
Band saw	42 ins.	Fay & Egan Co.
Tenoner	3½ ins.	Fay & Egan Co.
Shaper	No. 3.	Clement
Surfacer	7x24 ins.	Whitney
Scroll saw	No. 6.	Fay & Egan Co.
Sander	84 ins.	
Wood-carving machine		
Wood lathe		

Pattern lathe	24 ins.	Fay & Egan Co.	
Universal saw bench		American Wood Working Mach. Co.	
Sash mortiser		Greenlee Bros. & Co.	
Combination rip and cut-off saw		S. A. Woods Machine Co.	
Self-feed rip saw	No. 3	Greenlee Bros. & Co.	

Tools in this list are belt driven from two line shafts.

L. & N. R. R.—SOUTH LOUISVILLE.

Machine.	Size.	Maker.	Motor H. P.
Carriage cut-off saw	No. 2	Fay & Egan Co.	30
Rip saw		Bentel & Margedant	
Rip saw		Bentel & Margedant	
Planer and matcher	No. 8	Fay & Egan Co.	
Tenoning machine	No. 2	Fay & Egan Co.	
Combination universal woodworker and moulder	No. 3	Fay & Egan Co.	
4-side 4-in. moulder	No. 1½	Fay & Egan Co.	
Pony planer	24-in. blade.	Goodell & Waters Co.	
Mortiser	No. 71	Fay & Egan Co.	14
Vertical double spindle boring machine	No. 2	Fay & Egan Co.	
Double spindle shaper	No. 2½	Fay & Egan Co.	
Mortiser and relisher	No. 93	Fay & Egan Co.	
Combination saw and dado	No. 5	Fay & Egan Co.	
Single head shaper		Fay & Egan Co.	
Grindstone		L. & N. R. R.	
Sand papering machine	No. 4	Fay & Egan Co.	18
Combination panel carver and friezer	No. 4	Fay & Egan Co.	8
Plug cutter		Fay & Egan Co.	
Scroll saw		Fay & Egan Co.	
Marquit veneer saw		L. & N. R. R.	
22-in. x 12-ft. lathe		Putnam Machine Co.	

List of Wood-Working Machinery in Representative Railway Shops—Pattern Shop

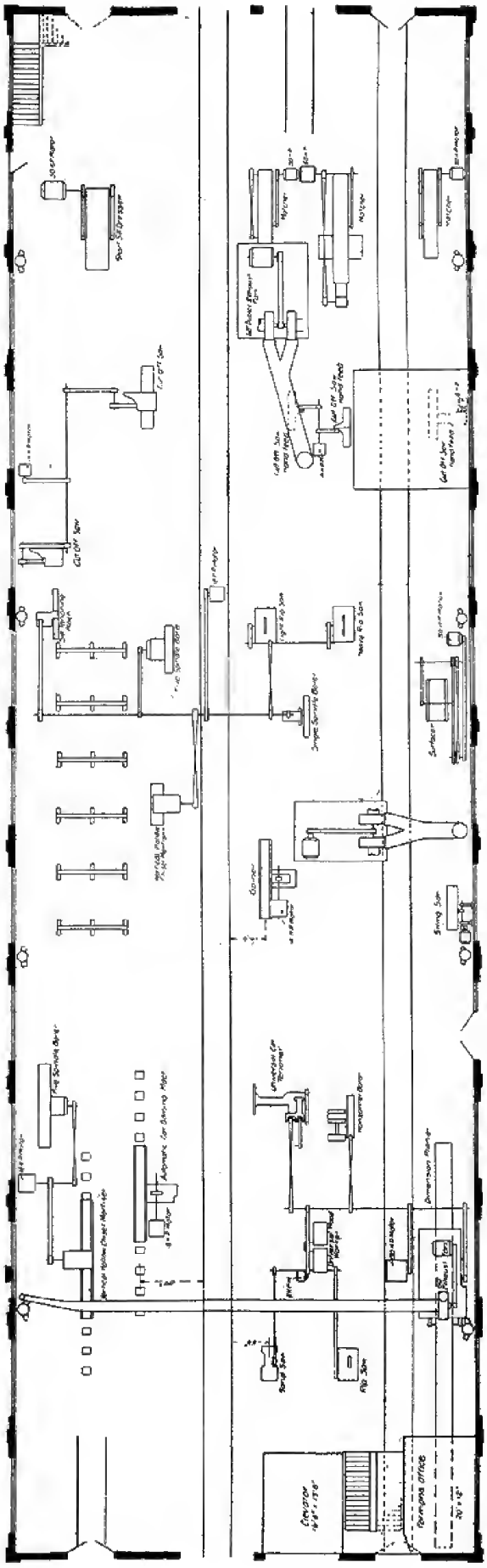
PENNSYLVANIA RAILROAD—SOUTH ALTOONA.

Machine.	Size.	Maker.	Motor H. P.
Rip saw	36x72 in. table	P. R. R.	5½
Rip saw	48x76 in. table	L. Wright	3½
Band saw		Berry & Orton	2½
Band saw, type B	½ in. saw blade	Oliver Machine Co.	3½
Lathe	25 and 50 in. swing, 8 ft. bed	Putnam Machine Co.	25
Power band saw filing and setting mach.		Atlantic Works	
Drill press		P. R. R.	
Core box machine		J. A. Crane & Co.	
Grindstone	28 ins.		
Automatic knife grinder	30 ins. No. 40	Springfield Mfg. Co.	
Lathe	20 ins. x 6 ft. 9 ins.	P. R. R.	
Lathe	30 ins. x 11 ft.	P. R. R.	
Lathe	30 ins. x 22 ft.	P. R. R.	
Face lathe	90 ins.	P. R. R.	
Band saw, type B	½ in. saw blade	Oliver Machine Co.	3½
Universal saw bench	14 in. saw	Oliver Machine Co.	3½
Universal saw bench	14 in. saw	Oliver Machine Co.	3½
Hand planer and jointer	20 ins.	Oliver Machine Co.	3½
Buzz planer and jointer		L. Power & Co.	3½
Heavy planer and surfacer	24 ins.	Atlantic Works	5½
Face plate lathe, type D		Oliver Machine Co.	3½
Planer	30 ins.	R. Ball & Co.	5½

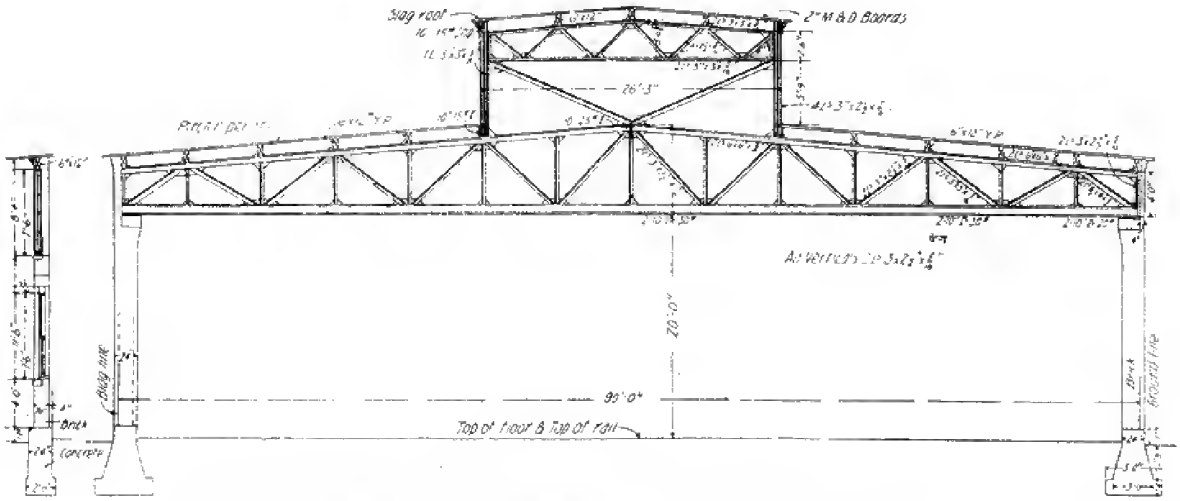
L. & N. R. R.—SOUTH LOUISVILLE.

Machine.	Size.	Maker.
Pattern makers' gap lathe	25 to 50 ins. swing, 10 ft. bed	Putnam Machine Co.
Wood lathe	16 ins. x 8 ft.	
Metal lathe	12 ins. x 4 ft.	Wm. Sellers & Co.
Oliver hand planer and jointer	20 ins.	Am. Wood Wkg. Mach. Co.
Hand surface planer	24 ins.	Fay & Egan Co.
Oliver Universal Saw Bench		American Wood Working Mach. Co.
Band saw		Fay & Egan Co.
Drill	20 ins.	W. F. & J. Barnes
Fox trimmer		Grand Rapids Machy. Co.
Crank shaper	18 ins.	Am. Wood Wkg. Mach. Co.
Grindstone		

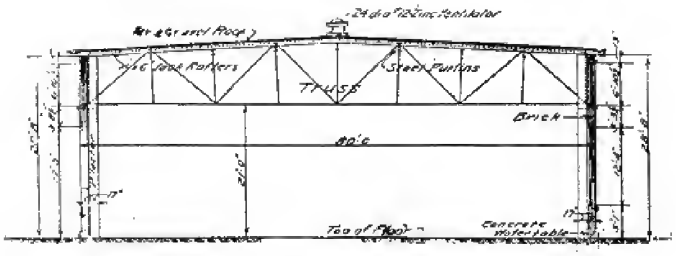
The machine tools are arranged in one group and driven by a 14-h.p. motor.



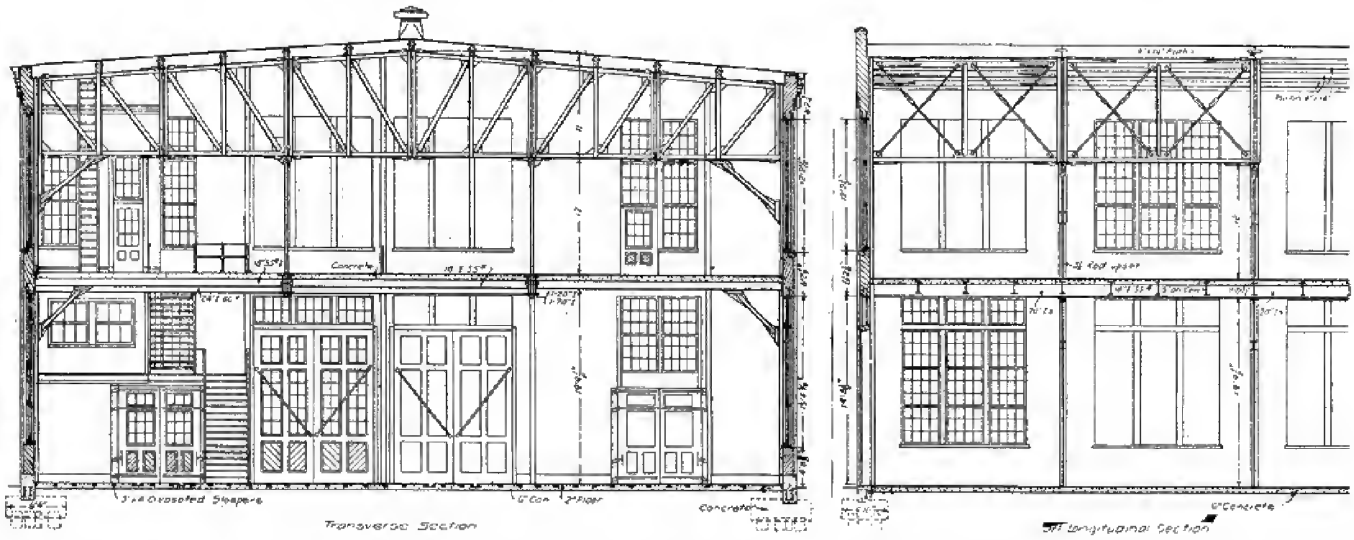
PLAN OF PLANING MILL, SHOWING LAYOUT OF EQUIPMENT AT SOUTH LOUISVILLE, KY., L. & N. R. R.



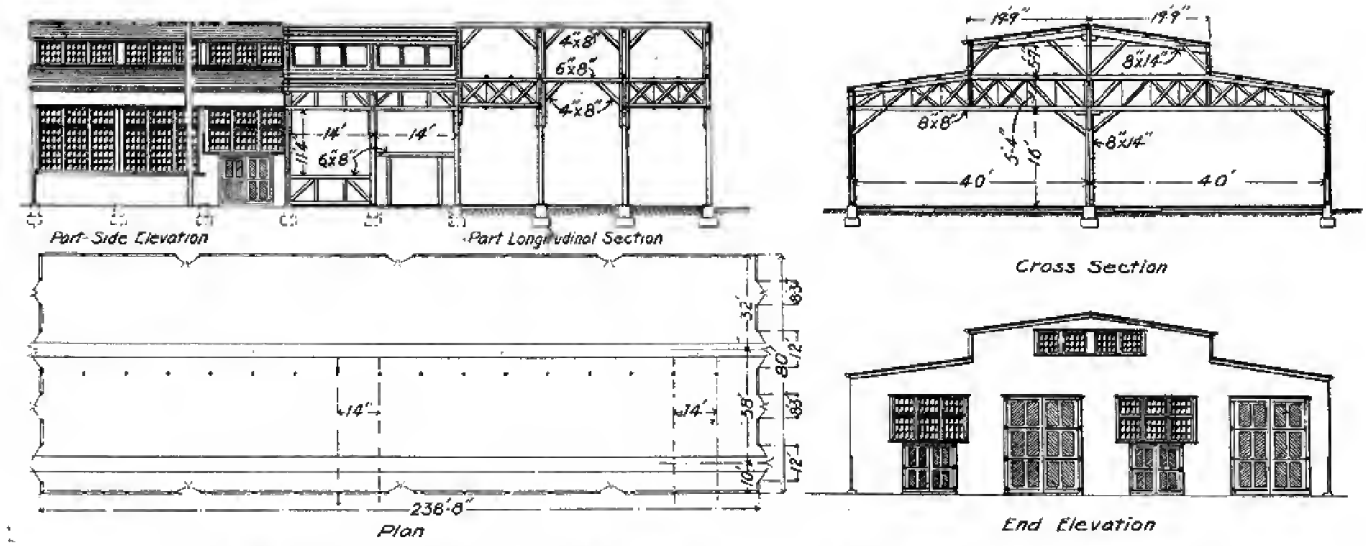
CROSS SECTION OF PLANING MILL AT SCRANTON, PA., D. L. & W. R. R.



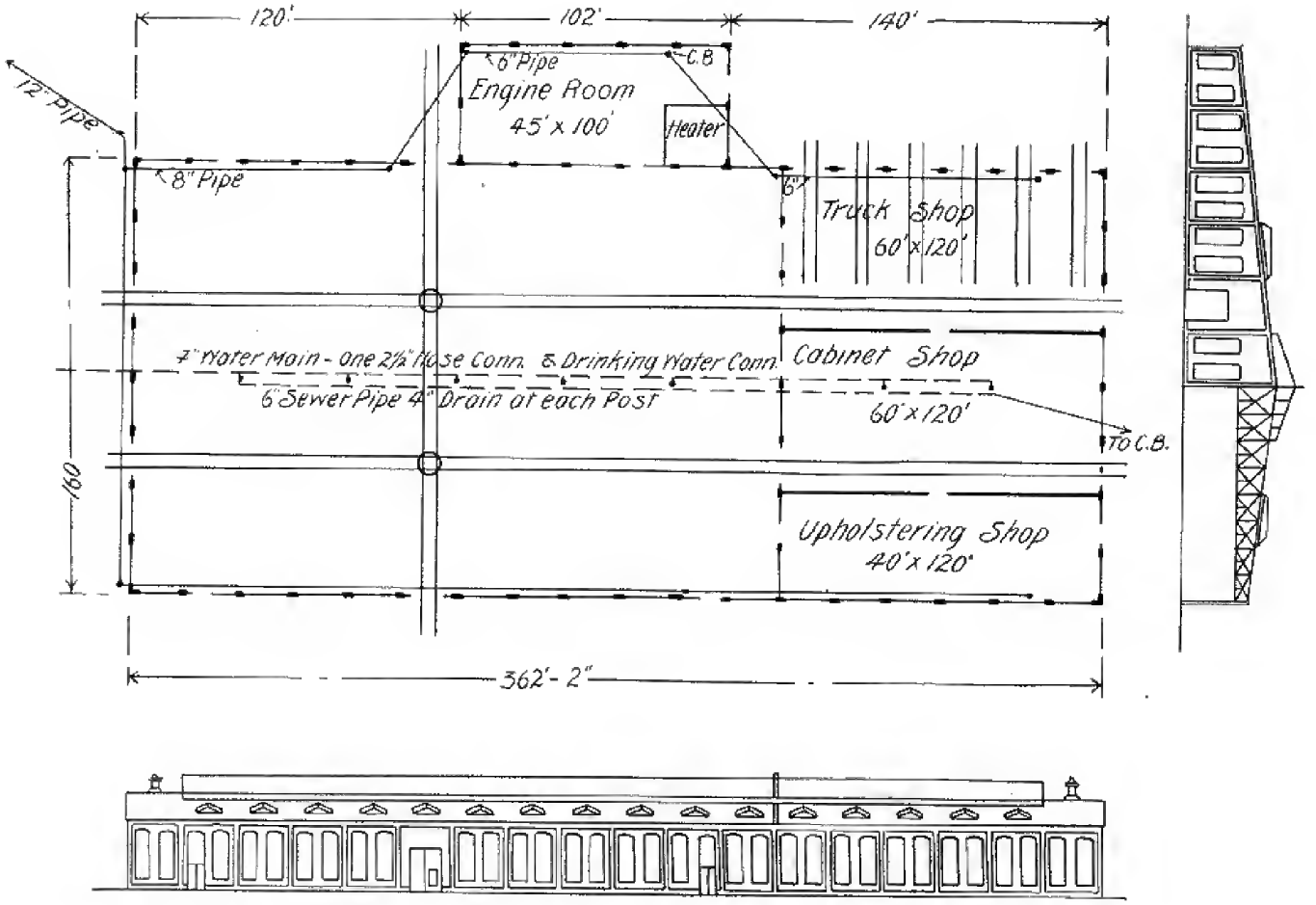
CROSS SECTION OF PLANING MILL AT SEDALIA, MO., M. P. RY.



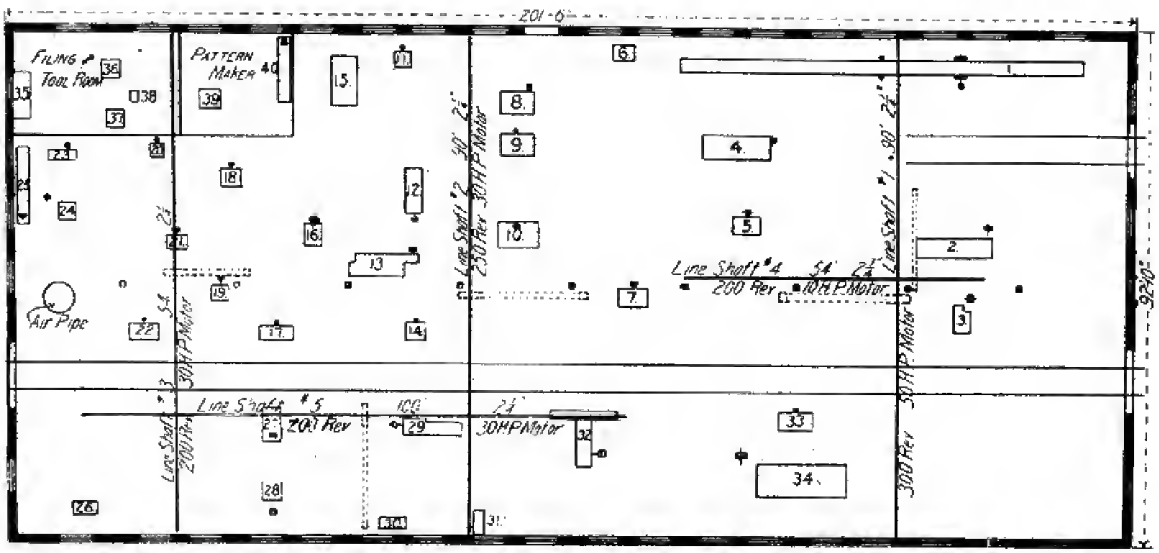
SECTION OF PLANING MILL AND COACH SHOP AT SOUTH LOUISVILLE, KY., L. & N. R. R.



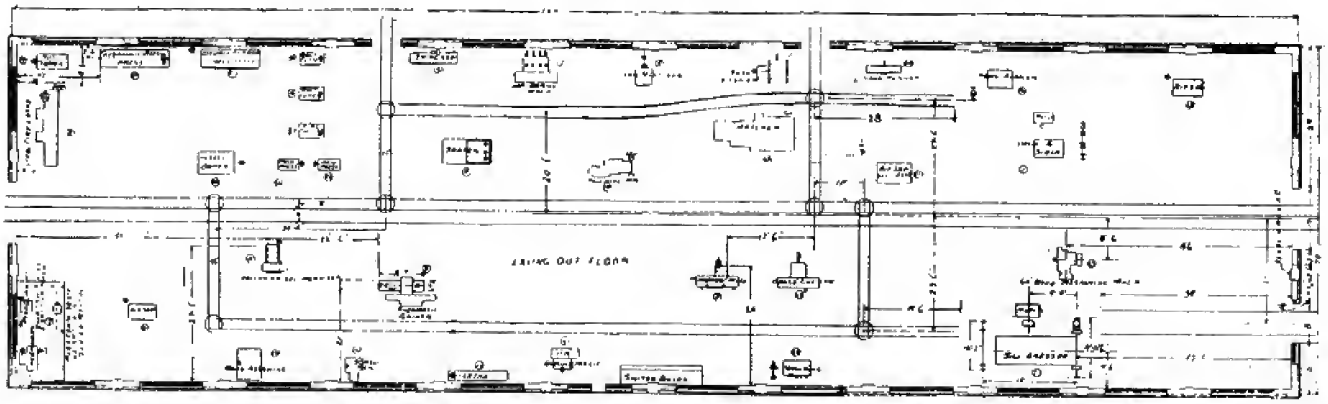
PLAN, ELEVATIONS AND SECTIONS OF PLANING MILL AT EAST DECATUR, ILL., WABASH R. R.



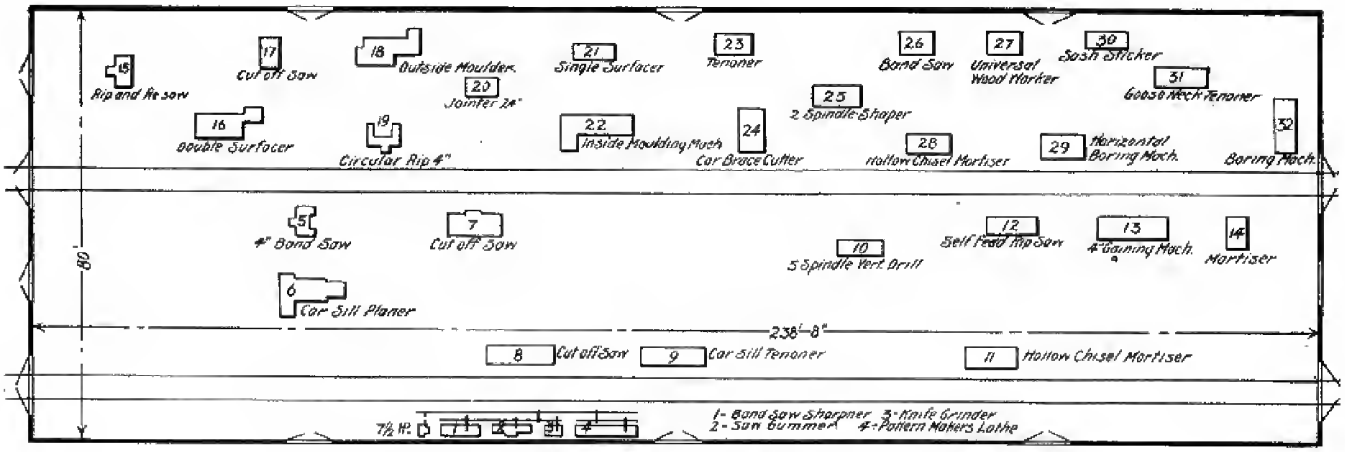
PLAN, ELEVATIONS AND PARTIAL CROSS SECTION OF PLANING MILL AT BURNSIDE, ILL., I. C. R. R.



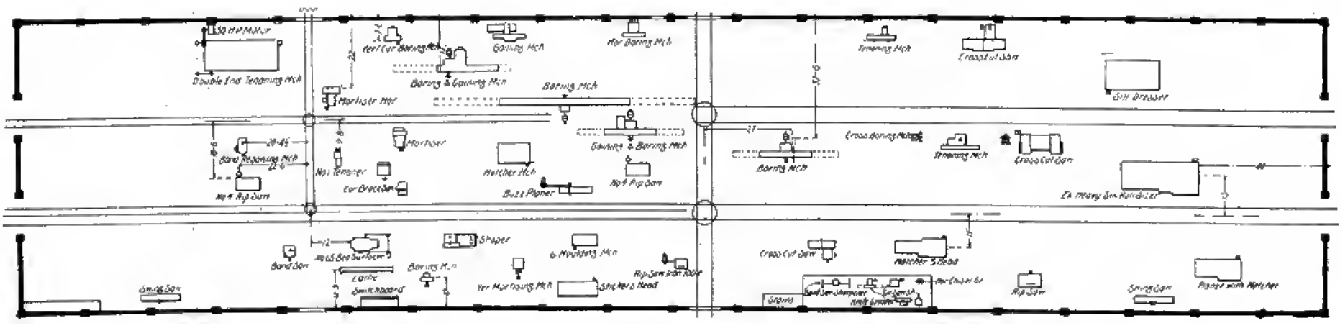
PLAN OF PLANING MILL AT OELWEIN, IOWA, C. G. W. R. R.



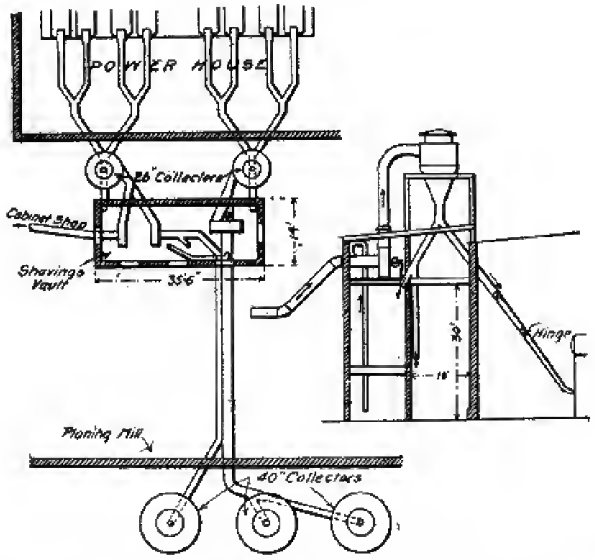
PLAN OF PLANING MILL AT KINGSLAND, N. J., D., L. & W. R. R.



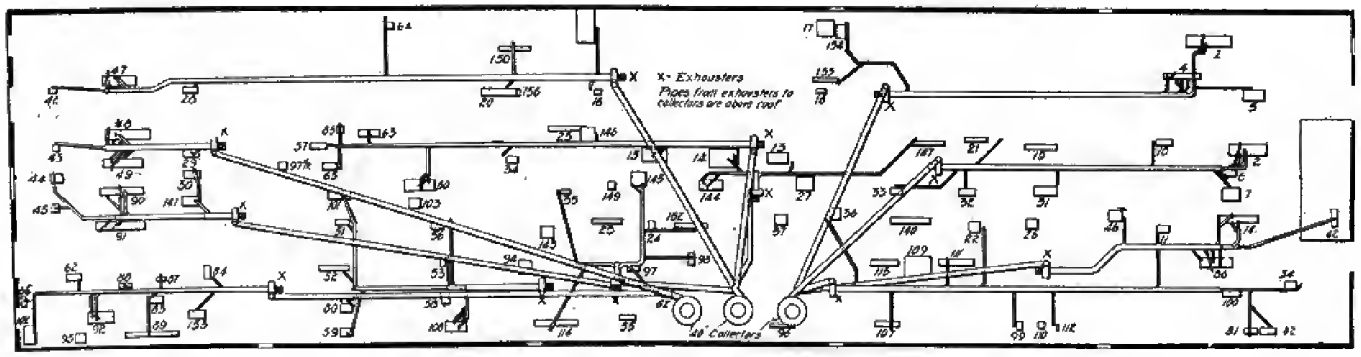
PLAN OF PLANING MILL AT EAST DECATUR, ILL., WABASH RY.



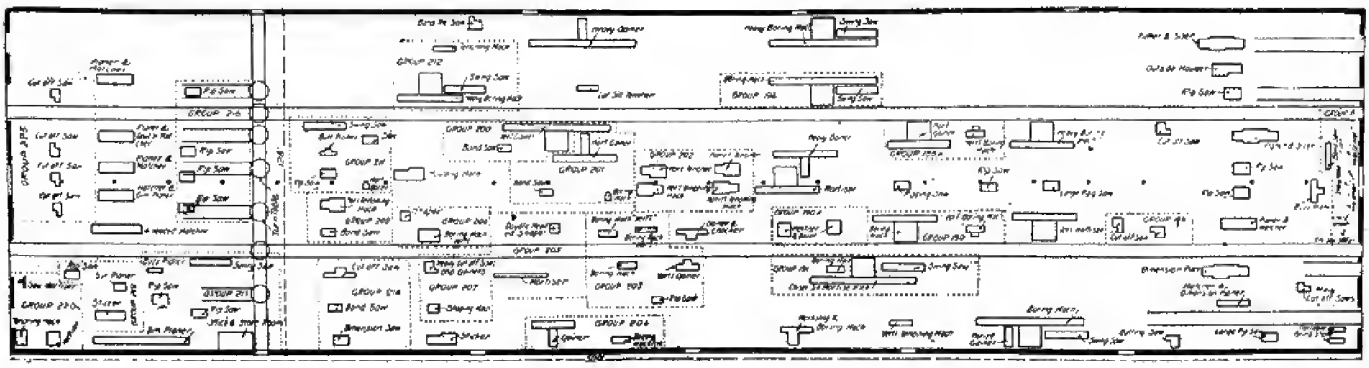
PLAN OF PLANING MILL AT SCRANTON, PA., D. L. & W. R. R.



EXHAUST SYSTEM FOR DELIVERY OF SHAVINGS FROM PLANING MILL TO POWER HOUSE AT ANGUS, C. P. RY.



PLAN OF PLANING MILL, SHOWING ARRANGEMENT OF SHAVINGS EXHAUST DUCTS, AT ANGUS, C. P. RY.



PLAN OF PLANING MILL AT ANGUS, C. P. RY.

Railway Shop Up to Date

Chapter IX.

FOUNDRY

UNTIL recent years the foundry was rare as a component part of a railway shop plant. Foundry work is entirely of a manufacturing nature and with the recent development of the large railway shop plant, the tendency toward the general introduction of the foundry as a principal department has become pronounced. Several railway general shops completed since the year 1902 include gray iron foundries as essential features and a number of shops now in course of construction include elaborate plans for foundry work. The tendency is to concentrate the foundry work for the entire system at the general shops, so that the foundry has not entered into the consideration of plans for minor and division shops.

A large number of shops have small brass foundries, but there is no information at hand of railroad companies having attempted either steel or malleable iron castings. Where there is an iron foundry at a shop plant, a small section is usually devoted to brass foundry work. Where there is no iron foundry the brass foundry usually occupies a section of the blacksmith shop building, and is completely separated from the remainder of the shop by a brick wall.

LIST OF FOUNDRIES AT RAILWAY SHOPS.

A gray iron foundry has been operated in connection with the Roanoke shops of the Norfolk & Western Railway for the past twenty or twenty-five years. The C., M. & St. P. Railway has long cast its own car wheels at its Milwaukee shops and in 1906 a modern car wheel foundry replaced the old one. In remodeling the Reading shops of the Philadelphia & Reading Railway a foundry was built in 1902. At Angus on the Canadian Pacific Railway there is a gray iron foundry and a car wheel foundry; and the South Louisville shops of the Louisville & Nashville Railroad include a gray iron foundry.

Wheel and gray iron foundries were operated in connection with the Altoona repair shops of the Pennsylvania Railroad previous to 1906. In that year a complete foundry plant, isolated from all other shops, was built at South Altoona. This plant at present consists of a wheel foundry, gray iron foundry, machine shop and material building, pattern shop, power house and an office building. The plot of ground on which the foundry plant is built is large enough to permit of future extensions to the present buildings and also for the addition of brass and cast steel foundries which have been considered. Foundry work for the entire system is concentrated, so far as possible, at this point and the plant is so located as to afford good shipping facilities to all parts of the system.

Plans for new shops on which construction work has been begun by the Delaware, Lackawanna & Western Railroad at Scranton, the Big Four at Beech Grove and the Grand Trunk at Battle Creek, make liberal provisions for foundry equipment.

GRAY IRON FOUNDRY BUILDING.

The construction of the foundries for gray iron castings which are already in operation and the design of those now under consideration, is in general very similar to the construction now usually followed in modern railway shop buildings, though in point of detail it is arranged for the specific class of work for which provided. The building is commonly a self supporting structure with brick walls. It is characteristic of foundries already built that they are well provided with ample natural light. A large proportion of the walls are given over to glass windows and in addition to the light so provided, that portion of the steel structure surrounding the center bay and extending above the roofs of the side bays, is equipped with glass windows. The roof of the center bay generally includes a monitor, with side window lights, extending nearly the full length of the building. At South Louisville the roof is of the same height throughout and light is admitted through the roof by saw tooth skylights.

The foundry building is usually divided into three bays, a main or central bay, from 55 to 70 feet in width, and two side bays, each about one half or little more than one half the width of the central bay.

The foundry at South Louisville varies from this general design. The main portion of the building is 318 feet long by 70 feet wide and is covered by a single span with no intermediate supporting columns. At one side is a narrow addition 20 feet wide extending the entire length of the building. Most of this additional area is included in the main floor of the foundry, but a portion of it is occupied by the cupolas, sand storage bins, ovens, etc.

As explained in connection with the provision for natural lighting, the roof trusses of the center bay are higher than those in the side bays. In the gray iron foundry at South Altoona, the height from floor to roof truss is 38 feet in the center bay and 21 feet in each of the side bays. At Angus these distances are 29 and 16 feet respectively. The plans for the foundry of the D., L. & W. at Scranton provide for a height of 35 feet in the center bay and 20 feet in each of the side bays. At South Louisville the height from floor to roof truss is 35 feet.

The lateral dimensions and area of the foundry can hardly be based on any specific unit and those foundries already in service are not enough alike in this particular to justify a definite conclusion. The foundry is not designed to meet the demands of a single shop but rather to supply an entire system. Its output is used by the locomotive department as well as by the car department, and also to some extent by the road department, so that a number of features enter into the determination of the output required.

The dimensions of several foundries, serve as records of those in railway shop service. At South Altoona, Pennsylvania Railroad, the gray iron foundry is 400 feet long by 130 feet wide; at Angus, Canadian Pacific Railway, the gray iron foundry is 342 feet by 122 feet; at Reading, Philadelphia & Reading Railroad, 564 feet by 163 feet; at South Louisville, Louisville & Nashville Railroad, 318 feet by 70 feet, and the foundry for the Delaware, Lackawanna & Western Railroad at Scranton will be 400 feet by 120 feet.

LOCATION.

As the foundry is a manufacturing department its location provides for the receipt of raw material and for the delivery of finished castings. Therefore its most convenient situation is adjacent to the avenue of distribution and communication among the shop buildings. This affords delivery of the finished material over the most direct route to the storehouse and to the various points of consumption. It is also essential that the transportation of raw material for the foundry shall not impede general yard traffic and on this account the foundry is frequently located at an extreme end of the plot occupied by the shop buildings.

It is generally considered desirable to have the foundry near the locomotive shop in order to provide for the shortest movement of the heavier locomotive castings. Castings for the car department are so much smaller that their delivery is a comparatively simple matter and they may be handled in bulk to good advantage. In view of the large amount of material for delivery to the line which is cast in the foundry an intimate communication between the storehouse and the foundry is essential.

LOCATION OF FOUNDRY AT ANGUS, C. P. RY.

At Angus, Canadian Pacific Railway, the foundry is next to the locomotive shop and is adjacent to the crane served avenue, or Midway, which traverses the shop yard. The store house is directly across the Midway from the locomotive shop and it is therefore evident that the store house is but a short distance from the foundry. The car erecting shop is adjacent to the Midway and the direct delivery of material from the foundry to this shop is very convenient. Castings are transferred in hand-car lots over the industrial tracks of the Midway.

The scrap and storage yard at one side of the foundry is served by a traveling crane of 20 tons capacity and this yard is entered by a delivery track connecting with the general yard system of tracks. Beyond the end of the foundry, opposite to the Midway, is additional storage space of large area.

The pattern shop and storage building are next to the foundry, with the crane served foundry yard between them.

LOCATION AT BEECH GROVE, BIG FOUR RY.

At the Beech Grove shops of the Big Four Railway, now under construction, the foundry is at the extreme end of the yard. One side of the foundry is served by the yard crane, and a platform, one side of which is partly under the yard crane, extends from the foundry to the store house. By this arangement there is no unnecessary handling of castings. Raw material enters one side of the foundry, and the finished castings are taken directly to their destination, or are stored on the store house platform, which is in the direct path of travel to any department. The pattern shop, although convenient to the foundry, is isolated from all other buildings for fire protection.

LOCATION AT SOUTH LOUISVILLE, L. & N. R. R.

At the South Louisville shops of the Louisville & Nashville Railroad, the foundry, with the pattern storage building near by, occupies a position at the extreme north end of the shop plant. The foundry is adjacent to a crane served storage yard to which the metal working portion of the plant is tributary. At the other end of this yard is a transfer table pit at right angles with the crane served yard. This pit traverses the plant between the locomotive shop and the car department shops and the store house is at the end of the transfer table pit away from the storage yard.

This location of the foundry was selected in pursuance of a plan to enter all raw material at the ends of the plant and work it toward the center where locomotives and cars arrive on the transfer table ready for delivery. While the foundry is not close to the store house and other points of destination for finished castings, it is in direct communication with them by means of the thoroughfare provided by the crane served yard and the transfer table pit.

CRANE SERVICE.

Crane service is an important factor in the operation of the up to date foundry. The main bay is served by one or more traveling cranes operated electrically and one or more of the side bays are sometimes served by a traveling hoist, usually controlled by hand from the floor. The traveling cranes are supplemented by portable jib cranes, so supported that they may be readily transported from one location to another as required. These are operated electrically or by hand. Where operated electrically plug connections are conveniently installed to provide for the delivery of current.

The crane of largest capacity in railway shop foundry service, of which information is at hand is in the South Altoona foundry of the Pennsylvania Railroad. This foundry is supplied with an unusually generous crane equipment which is worthy of especial mention.

The center bay of the foundry is served by a crane of 25 tons capacity and two cranes of 12½ tons capacity each. All of these cranes operate on the same runways with the heavier crane between the other two. The runways extend 280 feet beyond the walls of the building at each end. The ends of the building are so arranged that these traveling cranes may run out on the extended runways and thus serve outdoor storage spaces where flasks, heavy castings, etc., are stored, as well as the shipping tracks. The brick walls, except for a door 12 feet wide, extend up to the height of the crane runways and above them the space is closed by a lifting door which extends the entire width of the bay. This door is made of corrugated steel, and is arranged to swing inward so as

to allow the cranes to pass beneath it. It is operated by a mechanism driven by an electric motor. In addition to these cranes serving the center, there are a number of portable 5-ton jib cranes attached to the columns along the side of the bay.

The design of the building provides for each side bay to be served by an electric traveling hoist of 5 tons capacity operating on runways carried by the supporting columns of the steel structure.

At Angus the center bay is served by a traveling crane of 10 tons capacity, and a space, in the side bay, about 50 feet in length, devoted to the core room, is served by a 5-ton traveling hoist controlled by hand from the floor.

At Reading, the central bay is served by a crane of 10-tons capacity, while a portion of each side bay is served by a traveling air hoist of 1-ton capacity.

The floor of the foundry at South Louisville, is served by a crane of 20 tons capacity.

Plans of the foundry at Scranton provide for the center bay to be served by a crane of 15 tons capacity and one of 5 tons capacity operating on the same runways. The runways will be carried through one end of the building in order that the cranes may serve a casting platform beyond the end of the foundry.

DISPOSITION OF WORK.

The entire area of the main or central bay is used as a moulding floor, with the exception, sometimes, of a portion at one end which is reserved for cleaning the heavier castings that require the service of the crane. The side bays usually contain the cleaning room for lighter castings, foreman's office, small pattern storage space, fan rooms, floor for furnaces, core ovens, core room, cupolas, moulding machines, etc., and the lavatory usually occupies a portion of one side bay.

INDUSTRIAL TRACKS.

The main bay is generally served by a system of narrow gauge industrial tracks which completely encircles the floor and frequently includes a track which traverses the bay immediately opposite the cupolas. In the corners of the building and at the juncture of two tracks either curves or turntables may be installed, however, the turntable meets with greater favor as occupying less space and proving more satisfactory. A similar industrial system serves the immediate storage yard and provides for handling pig iron, scrap, coke, etc.

CHARGING FLOOR.

The charging floor is usually reached by an electric or hydraulic elevator, the latter receiving greater favor. At Angus delivery is made to the charging floor by the crane serving the storage yard.

The charging platform, as a general thing, is served by narrow gauge tracks of the same gauge as the surface industrial system, for delivering push cars to the cupola charging door and to the temporary storage spaces. It is common practice to store on the charging floor sufficient material to operate the cupolas for at least one day, in case of emergency. A narrow gauge track scale is introduced in the track system on the charging floor between the point of delivery and the charging door.

At Reading there is a transfer table on the charging floor which serves several spur tracks. Several loaded cars may be stored temporarily on these tracks and any one of them taken out individually.

CUPOLAS.

The railway shop foundry is usually equipped with two cupolas of about 18 or 20 tons capacity each. They are generally so situated as to be charged from the same charging floor. Cupolas are placed in one of the side bays and in such relation to the center bay that they may be tapped in the main floor within reach of the traveling cranes.

PATTERN SHOP.

Pattern storage is usually provided for in a building of fire proof or slow burning construction, located in close proximity to the foundry. This storage building is either isolated or is in connection with a pattern shop from which it is separated by a fire wall having door-ways that are equipped with sliding doors which are normally kept closed and which close automatically in the event of the temperature in the shop rising sufficiently to melt the fuse controlling the operating mechanism.

PATTERN SHOP AT ANGUS, CANADIAN PACIFIC RY.

At Angus the pattern shop is in a two story building occupying a ground space 82 feet by 50 feet. The building is of brick and the roof is supported by wooden columes dividing the floor space into three bays. Patterns are stored in a fire proof building of concrete and steel construction, 150 feet long by 100 feet wide. The roof is supported by 20 inch I beams at 15 foot centers, carried on the side walls and resting on a row of steel columns through the center of the building.

PATTERN SHOP AT SOUTH ALTOONA, PENNSYLVANIA R. R.

At South Altoona the pattern shop and storage room are in the same building but in two distinct sections. The building is of brick, 386 feet long by 91 feet wide. The section occupied by the pattern shop is one story high (16 feet from the floor to the underside of the roof trusses) and 193 feet long, while the pattern storage section is 180 feet long and three stories high.

The frame work of the section occupied by the pattern shop is of steel. Ample natural light is provided by large window areas in the walls and by glass in the skylight. Work benches are placed along the side walls and machines are grouped in the middle of the shop.

The shop is lighted by 32 enclosed arcs, and each work bench is provided with a 16-candle power incandescent light.

The pattern storage section is separated from the pattern shop by a 12 foot hallway, which contains the elevators and stairs. The framework of this part of the building is of heavy timber construction. It is divided by brick walls into three sections and the doors between these sections are of steel and normally closed. This part of the building is equipped with a sprinkler service, which is operated by valves placed outside of the building. Openings are made in the side walls at each floor to prevent the floor from becoming overloaded in case one of the rooms is flooded. Each section is provided also with fire extinguishers and fire hose.

All patterns except the very large ones are stored on shelves, and so arranged that they may be located readily by means of a card index system, and can easily be returned to their proper places on the shelves.

The storage section of the building is lighted by incandescent lights.

A narrow gauge track extends from this department to the foundries to facilitate the delivery and return of patterns.

WHEEL FOUNDRY.

The most notable examples of wheel foundries operated by railways are those of the Canadian Pacific at Angus, the Chicago, Milwaukee & St. Paul at Milwaukee and the Pennsylvania at South Altoona. At these points foundry practice in making cast iron car wheels has attained a high degree of development. These three foundries are operated much on the same principle and the general features in the design of the buildings are similar, though they may vary to some extent in point of detail. In all of them the straight floor system of moulding is used; each floor is provided with an overhead trolley hoist which travels the length of the floor, and a number of labor saving devices have been introduced.

At each of these foundries the building is a steel structure with brick walls. The building contains a single large working area on which the moulding floors are arranged and an addition along one side providing for the auxiliary departments, cupola, charging floor, core ovens, blower room, etc. Annealing furnaces, served by traveling cranes occupy positions at one or both ends and a shipping platform is arranged at one end or along one side to suit local conditions.

WHEEL FOUNDRY AT ANGUS, CANADIAN PACIFIC RY.

The wheel foundry at Angus, Canadian Pacific Railway, is the most likely illustration of the location of a wheel foundry as a component part of a railway shop plant. It is located where ample space is available for the storage of pig iron, scrap wheels, sand, etc., and where the foundry is convenient for the direct delivery of wheels to the truck shop. The wheel foundry is at one edge of the area occupied by shop buildings where the delivery of material offers no impediment to general yard traffic and between the wheel foundry and the truck shop is a large area for the temporary storage of wheels. The provision for this storage space is worthy of more than mere passing mention for the experience of the Angus shops indicates that the absence of such a storage yard in close proximity to the truck shop would have been a serious handicap.

The wheel foundry is 187 feet long by 107 feet wide, the area within these dimensions including the moulding floors and the annealing pits. An additional portion of the building 90 feet long by 27 feet wide includes two cupolas and the various auxiliary features. The annealing pits are at one end of the foundry and the shipping platform is at this end immediately outside of the building. The floor above the annealing furnaces is 4 feet above the main floor of the foundry and on the same level as the shipping platform. The annealing furnaces are served by a single crane spanning the entire space occupied by them. The foundry has a capacity of 300 wheels per day. The wheels are poured on 15 floors of 20 wheels each.

WHEEL FOUNDRY AT MILWAUUEE, C., M. & ST. P. RY.

The present wheel foundry at Milwaukee, Chicago, Milwaukee & St. Paul Railway, is modern in every particular and replaced an old wheel foundry which operated seven circular floors, pouring 26 wheels to the floor, with a total daily capacity of 182 wheels. The new foundry has a capacity of 600 wheels per day. The entire building is 364 feet long with a maximum width of 159 feet, this width including a lean-to 31 feet wide, which contains the cupolas, wheel stacking room, core ovens, etc. A brick curtain wall separates the core room and cupola house from the remainder of the foundry and the blower room which is on a level with the cupola platforms, is entirely enclosed and is provided with a concrete floor. The foundry is divided into 24 floors of 24 wheels each and this portion occupies a space 288 feet by 128 feet. The cupola house is 96 feet 5 inches by 31 feet. The annealing furnaces occupy a space approximately 125 feet by 40 feet 8 inches. The pits are spaced 6 feet between centers. There are 144 pits, each 36 inches in diameter and having a capacity of 16 wheels. The pits are of steel plate, lined with fire brick and having a double layer in the bottom. The annealing floor is 4 feet 3 inches above the foundry floor and has a concrete retaining wall.

The cupolas are of the manufacturers standard type, 96 inches in diameter and lined to a diameter of 78 inches. Each has a wind box 118 inches in diameter and the height from the floor to the top of the stack is 50 feet. The cupolas are so located that each one can conveniently serve 12 of the floors. The total melt of the two cupolas is about 220 tons, or at the rate of 20 tons per hour each. They are provided with operator's platforms, which likewise serve as platforms for the tapper.

The cupolas practically divide the foundry into halves and each has a capacity to serve 12 floors. The ladle track is in front of the cupolas, while the hot wheel track is on the opposite side, with the floors arranged transversely between them. The trolley hoists serving the floors are operated by compressed air. The cylinder and valves for the hoist are supported on the wall at the side of the foundry opposite to the cupolas where they are out of the way of dust and dirt from the floors.

Two trains of hot metal cars operate on a narrow gauge track, each traversing half the length of the foundry. Each train is made up of 4 cars and is moved by a rope haulage system operated by an electric motor, controlled by the operator in charge of the receiving ladle. Each car will hold two ladles of 1,000 lbs. capacity each. One loaded ladle is placed at one end of the car, leaving room for an empty ladle at the other end.

The cars are so spaced as to serve four floors at the same time. The ladle is transferred form the car to any desired point over the floor by the trolley hoist where the metal is poured and the ladle returned to the car.

When the wheel is sufficiently cool it is shaken out and gripped on the edge by tongs depending from the trolley hoist. When lifted it is suspended in a vertical position and the loose sand which does not fall away when the wheel is raised can be knocked off with a sledge. This edge grip places the wheel in position to be deposited by the hoist on the buggies which operate over the hot wheel tracks along the ends of the floors. Methods in more common use for handling hot wheels with the hoist provide for gripping the wheel at three points and lifting it to a horizontal position. Hot sand is then shoveled from the upper side of the wheel and rapped from the bottom.

The hot wheel buggies are operated in trains of four cars each over two tracks. The buggies have a capacity of one wheel each and are operated by a rope haulage system, similar to that operating the hot ladle buggies. Their movement is controlled by an operator on a stationary platform attached to the side of the building and overlooking the tracks.

The buggies convey the wheels to the end of the foundry at which the annealing pits are located. The pits are served by three special 1 ton electric traveling cranes. Each crane serves two rows of pits and is equipped with two 1,000-lb. hoists from which center bore tongs are suspended. Wheels are lifted from the buggies by these tongs and deposited in the pits to be annealed.

Connection between the hot ladle tracks and the hot wheel tracks is made by means of a narrow gauge track outside of the building equipped with turn tables at the points of juncture. The same track system provides for connection to the storage yard. The storage yard is well provided with a narrow gauge industrial track for the delivery of material.

Before the wheels are lifted from the buggies by the pitting cranes, the heads are knocked off of the wheels and they are conveyed in buggies over these industrial tracks to the storage yard, where they are used for making up charges for the cupolas.

The cupola charging floor is served by two pneumatic elevators of 4 tons capacity each, having 20 inch cylinders with 11 foot stroke and a lift of 22 feet. Each elevator has a steel cage 6 by 8 feet and is provided with tracks on which coke, pig iron and scrap buggies are carried from the ground floor to the charging room. In addition to two main tracks there are four storage tracks on the charging floor on which coke and metal can be stored while the heat is in progress. Turn tables are conveniently located so that both cupolas are amply provided for. In addition to the pneumatic elevators the floor can be reached by a steel staircase from the charging department.

Metal from the cupolas is tapped into 10-ton receiving ladles which are tilted by 13 horse power electric motors operated from an adjoining platform by the operator who controls the hot ladle cars. The receiving ladles are equipped with skimming spouts and are provided with an emergency hand power mechanism beneath the operator's platform. The operator is shielded by a steel protecting plate.

The three core ovens are served by a small transfer table which provides for shifting and distributing the special buggies on which the cores are run into the ovens. These buggies are really portable shelves on which they remain while in the ovens. Cores are delivered to the various floors by being placed on platforms and carried to their destinations by the hot ladle cars.

WHEEL FOUNDRY AT SOUTH ALTOONA, PENNSYLVANIA R. R.

The wheel foundry at South Altoona has a capacity of 900 wheels per day. The interior is a single room 600 feet long by 186 feet wide, with no divisions between the moulding floors, annealing pits and cleaning rooms, but with a space 410 feet by 60 feet enclosed for the cupola, sand storage, core and wash rooms. These rooms have brick partitions. The side walls include large areas of glass and the monitors, which extend across each section of the building, have skylights extending their entire length, with the result that ample natural light is provided. The monitors are wide and high and equipped with swinging sash, thus affording good ventilation.

With the exception of the cleaning room and annealing pits at each end of the building, the foundry is divided into three working divisions. Each division includes 12 moulding floors of 25 wheels each and is served by two 86 inch cupolas. Each cupola has a capacity of 12 tons per hour.

The core room is equipped with two sets of three ovens. A coke furnace beneath each oven is fired from a pit under the core room floor. It has two flues which deliver the gases to the rear corners of the oven, where they rise, pass up through the shelves at the back to the top and then return to the floor and to the outlet at the lower front corner. In the center of each oven is a vertical shaft with collars which support seven shelves of 3-16 inch perforated tank steel 10 feet 6 inches in diameter and spaced 13⅛ inches apart. The shelves are mounted on ball bearings and revolve independently.

Between the two sets of ovens is a sand bin 40 feet by 28 feet 10 inches, having a capacity of 550 tons, with wooden walls 2½ inches thick, supported by an outside steel frame work of 12 inch I beams.

Two sets of annealing pits occupy positions at opposite ends of the foundry. The space covered by the pits at each end is approximately 140 feet by 41 feet. The pits are enclosed by masonry retaining walls which rise about 8 feet above the foundry floor. The walls thus form a large pit which contains the annealing furnaces or cylinders. The bottom of this pit is covered with 6 inches of concrete, sloping toward one corner for drainage. The furnaces are arranged in four rows, 25 in each row, and are carried on concrete benches or platforms 18 inches above the bottom of the pit. The rows are arranged on 11 foot centers and the furnaces are 18 inches apart. Each furnace has a capacity of 25 wheels. It is made of ⅜ inch sheet steel, is 16 feet deep, and is lined with fire brick 6 inches thick. The space between the supporting platforms is filled with coarse broken stone. Between the furnaces is a layer of fine stone and above this the space is filled with green and burned sand extending to the top of the wall.

Each lot of annealing furnaces is served by a traveling crane having a span of 44 feet and a capacity of 4,000 lbs. This crane has four independent hoists, spaced 11 feet apart, each driven by a 7½ horse power motor, controlled separately from the cab. The crane is operated by a 10 horse power motor and traverses at a speed of 500 feet per minute. The hoists operate at speeds up to 100 feet per minute. There is a spare hoist on the bridge and an extra motor for traversing which can be connected quickly in case of accident to the regular motors.

A space 11 feet wide is devoted to each moulding floor and a row of 25 flasks are set on a pair of rails spaced 24 inches apart. The trolley hoists serving the floors are operated electrically and both the traversing and hoisting operations are controlled by one handle which can be reached conveniently from the floor. They have several hoisting speeds, ranging from 16 to 75 feet per minute and a range of traversing speeds up to 400 feet per minute. The nominal capacity is a lift of 1,000 lbs., at 60 feet per minute.

Each pair of cupolas discharges into a delivery ladle of 14,000 lbs. capacity, consisting of a brick lined steel shell mounted on trunnions. The ladles are tilted by a chain which passes over a sheave on the end of the trunnion shaft and is operated by an hydraulic cylinder located underneath the bed plate and controlled by a valve conveniently placed. The delivery ladle is so arranged that the flow from the cupola does not have to be stopped while the ladle is being tilted to supply the pouring ladles.

The storage yard is well provided with a narrow gauge industrial system for the delivery of material. The charging floor is served by an hydraulic elevator of 5 tons capacity.

FOUNDRY SYSTEMS AT ANGUS, CANADIAN PACIFIC RY.

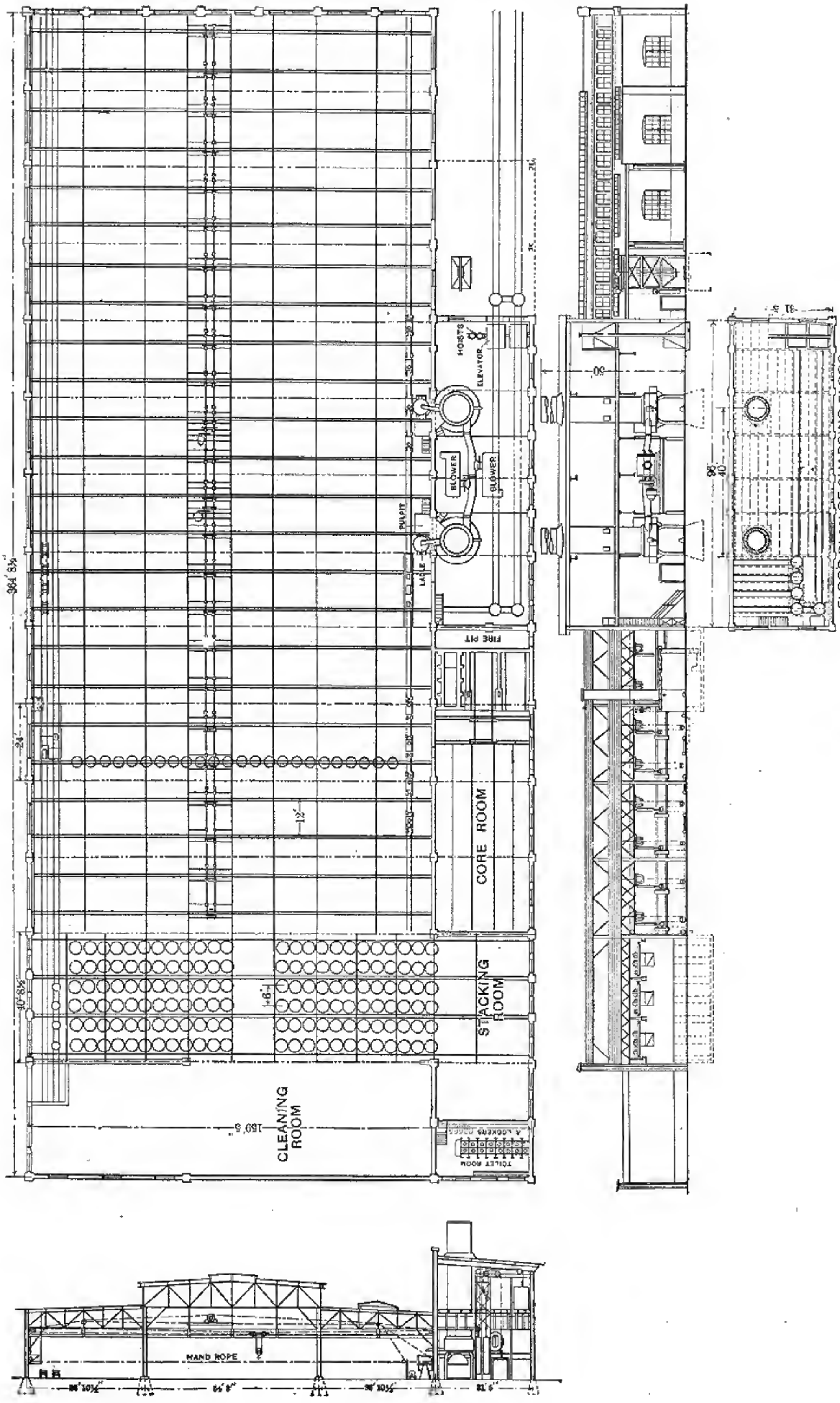
A brief outline of the operation of the foundries at Angus is interesting as referring to the practices of a railway shop plant which has successfully operated both wheel and gray iron foundries for several years. The two foundries, gray iron and wheel, turn out the majority of gray iron castings for the entire system and the total wheel supply for the road. They are treated very much as the railroad company would treat an outside concern, so that the same service, or better, may be exacted from them as would be expected from outside foundries. They are operated by the car department and the master car builder is directly responsible for them. At the same time the total intake of raw material and the output of finished castings are considered as the property of the general storekeeper and in order that accurate account may be kept and reported to this official, the intake and output are checked and weighed by employees of the store department.

Material passing through the gray iron foundry is taken care of by two foundry checkers and one foundry clerk, whose offices are located in the scale room through which all material must pass on its way to the cupolas, so that nothing goes into the cupolas without first crossing the scales and being correctly weighed by the clerk of the stores department. These weights are posted in a book kept for the purpose and the total cost covering intake of the foundry is made up from these records of material used. All material required for the operation of the foundry is so recorded and is issued without the usual shop form. This includes material delivered to the cupolas, such as pig iron of various brands, broken wheels, scrap, coke, manganese, etc., as well as material used in the foundry proper such as sand, facings, flour, hay, etc.

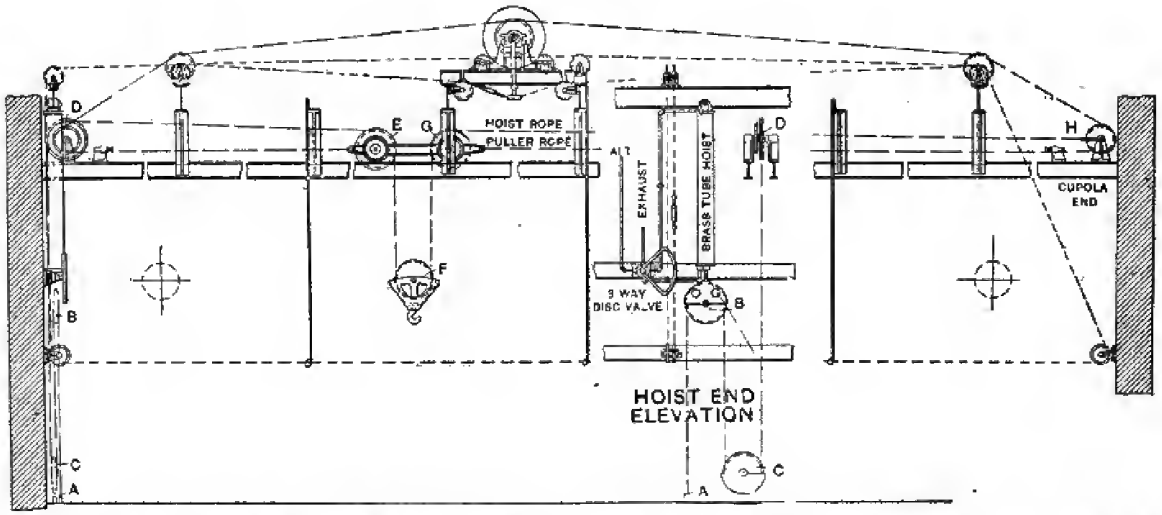
As it would naturally be an inadvisable proposition to deliver castings from the foundry to the store house and then rehandle them to the several shops, the foundry is considered much in the light of a sub-store house, or petty store, as far as deliveries are concerned. Therefore all castings for the several departments are loaded in lorry loads of about two tons each, classified according to the department to which the load is to be delivered in order that material for different departments will not become confused and the castings are delivered direct to the shop in which they will be assembled or machined. Line shipments, however, are sent to the store house where they are loaded into cars and forwarded to their several destinations.

The output, allowing for shrinkage, is always a check on the intake, yet, in order that correct record may be arrived at, all castings made in the gray iron foundry when cleaned and ready for delivery, are checked as to pattern numbers, weighed, and as each load is checked on the scale the list of various items making up the load is signed by the foundry checker (who retains a copy of the same) and handed back to the representative of the foundry foreman as his authority for delivery.

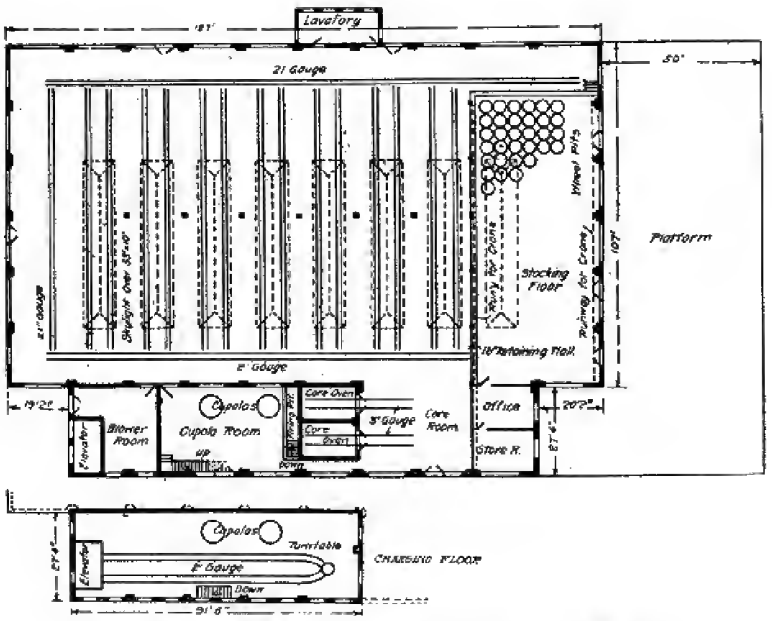
The wheel foundry is handled on precisely the same line as that outlined for the gray iron foundry, except that wheels for line shipments are not delivered to the store house, but, are loaded from the foundry platform to prevent any unnecessary handling. All wheels are charged at the same price per 100 lbs., as are ordinary castings with the exception of cylinders and wheel centers. The total cost is arrived at by adding pay rolls to value of material used, plus shop expense charges.



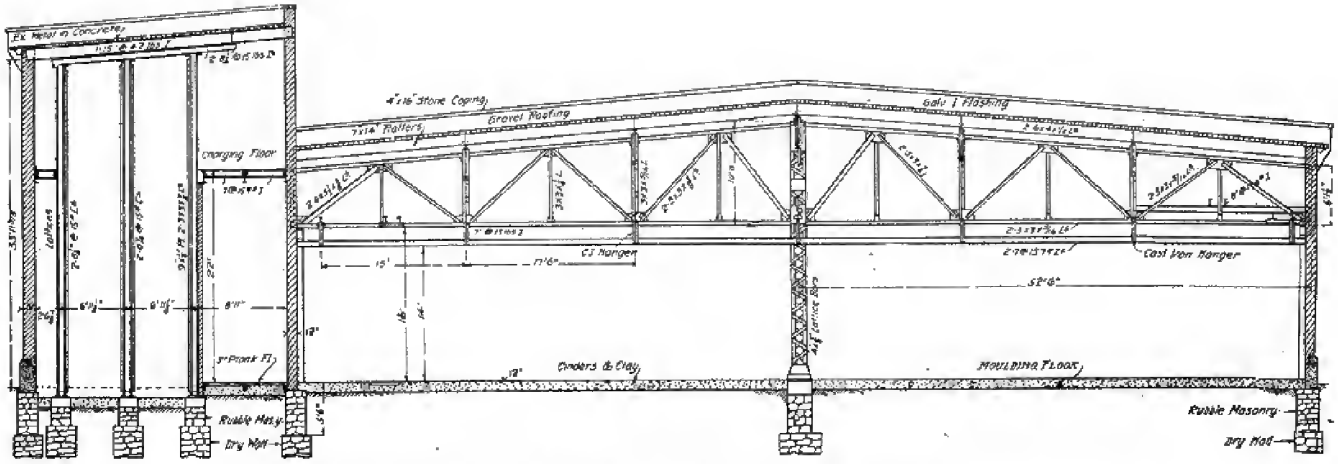
PLAN, END AND SIDE ELEVATION OF WHEEL FOUNDRY AT MILWAUKEE, WIS., C. M. & ST. P. Ry.



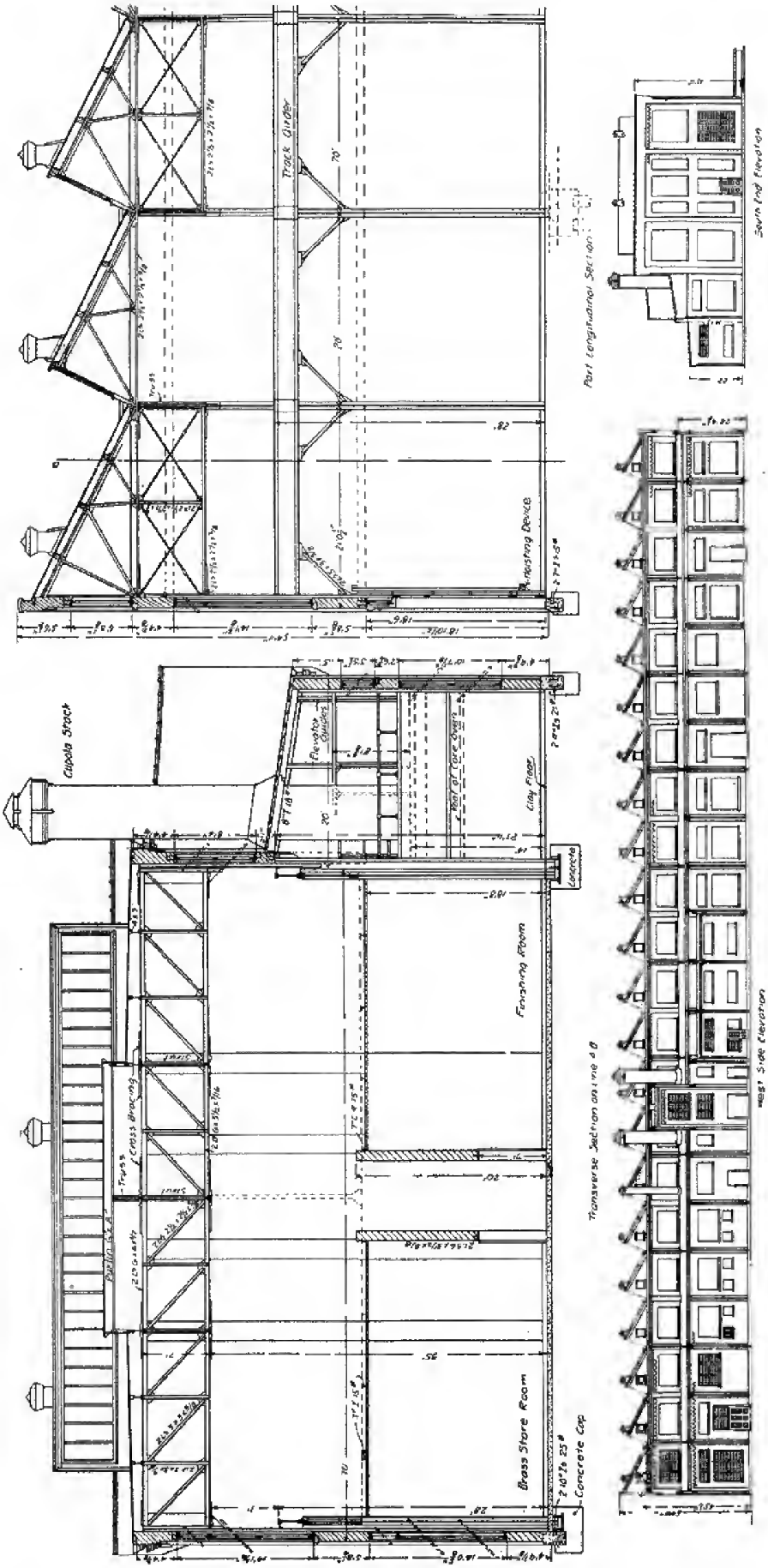
DETAILS OF FLOOR, TROLLEY HOIST MECHANISM IN WHEEL FOUNDRY AT MILWAUKEE, WIS., C. M. & ST. P. RY.



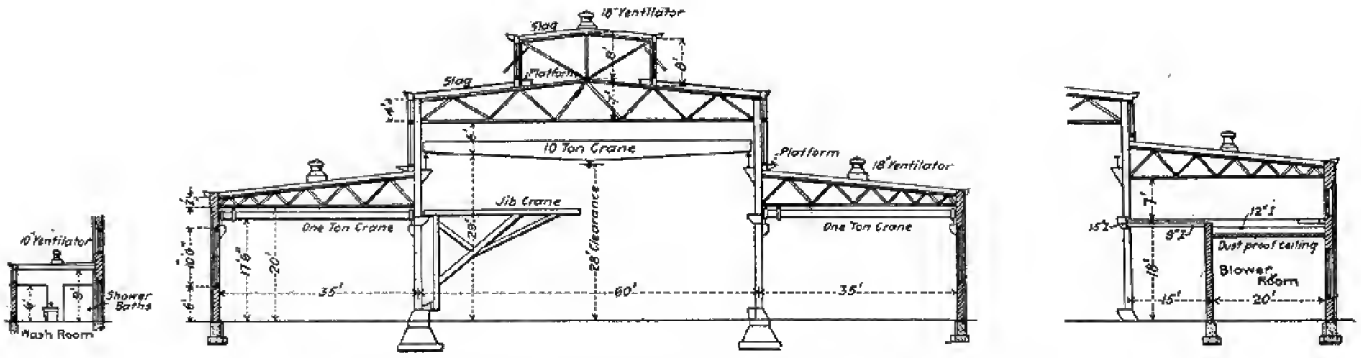
PLAN OF WHEEL FOUNDRY AT ANGUS, C. P. RY.



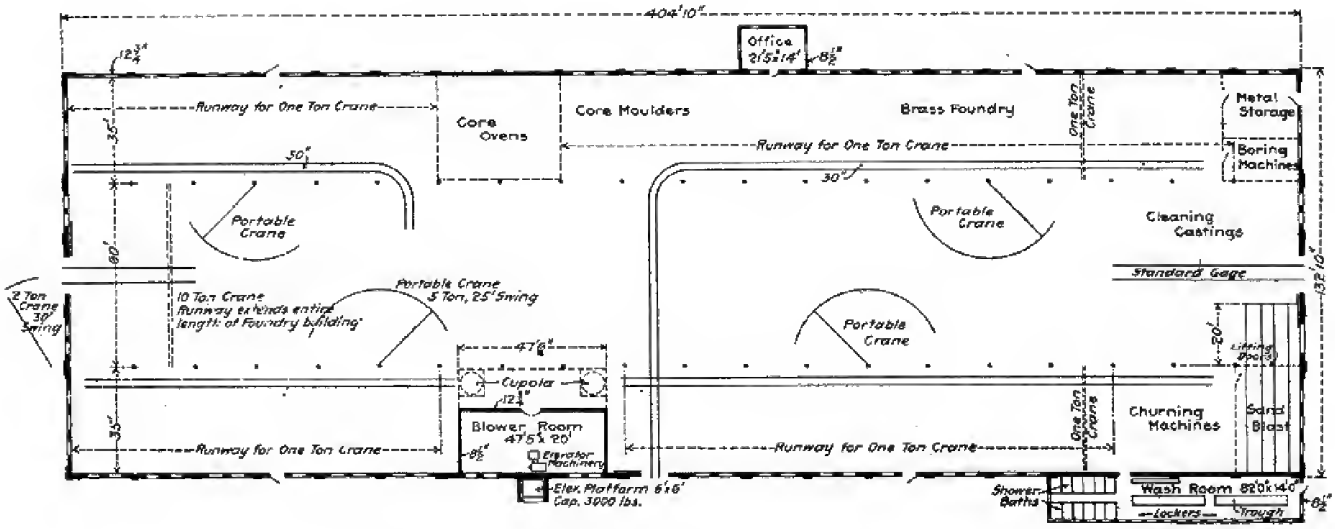
CROSS SECTION OF WHEEL FOUNDRY AT ANGUS, C. P. RY.



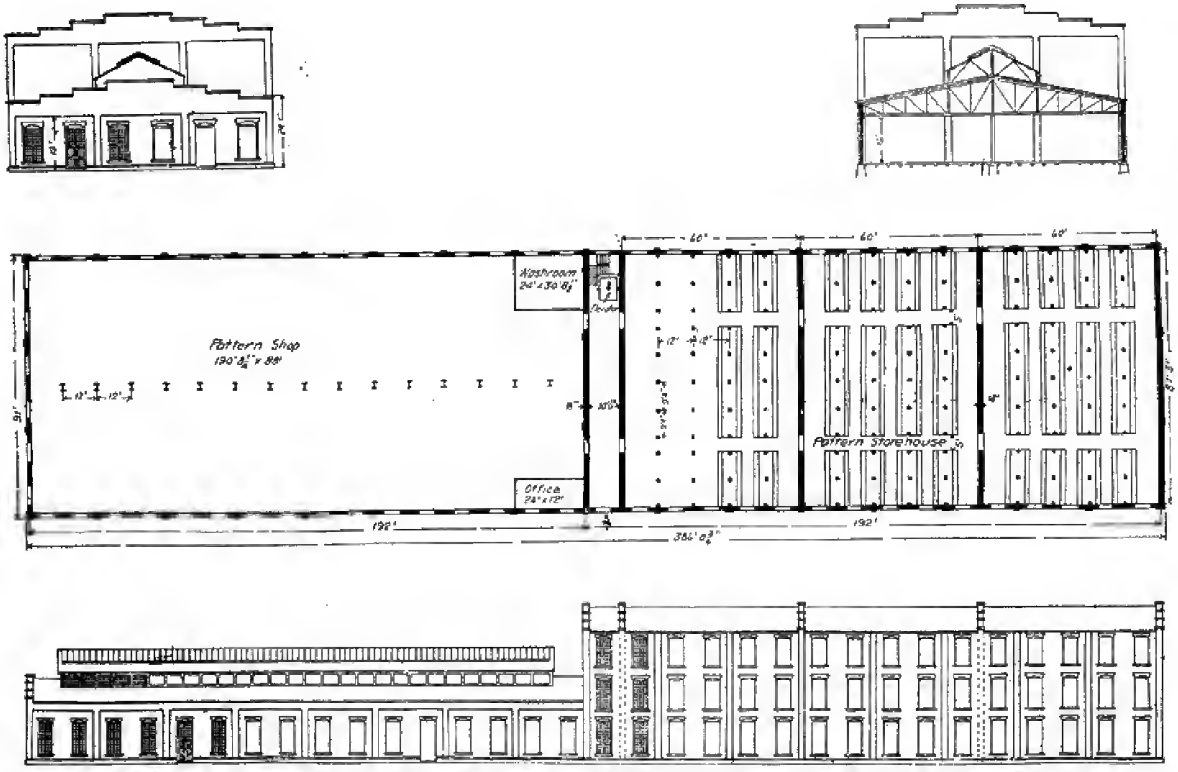
SECTIONS AND ELEVATIONS OF GRAY IRON FOUNDRY AT SOUTH LOUISVILLE, KY., L. & N. R. R.



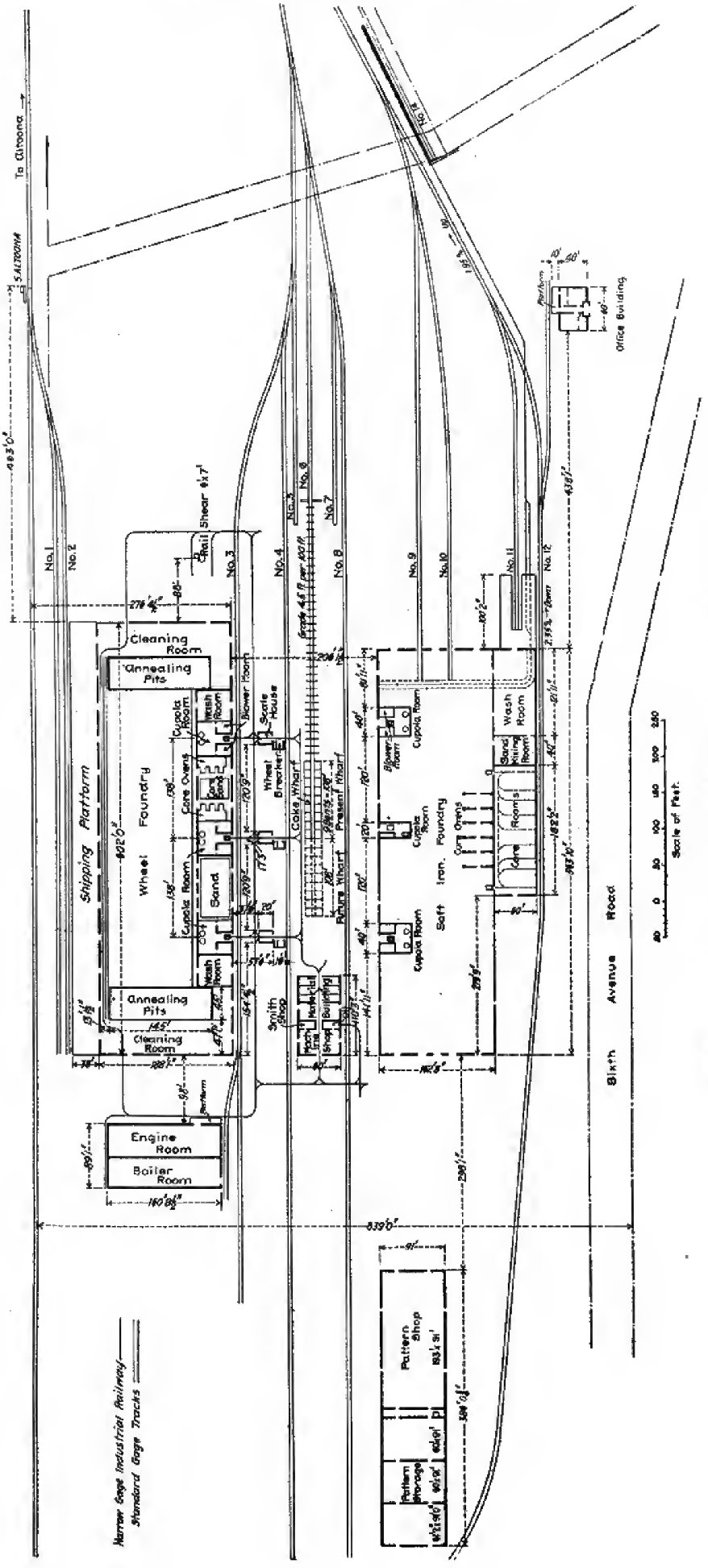
CROSS SECTIONS OF FOUNDRY AT READING, PA., P. & R. R. R.



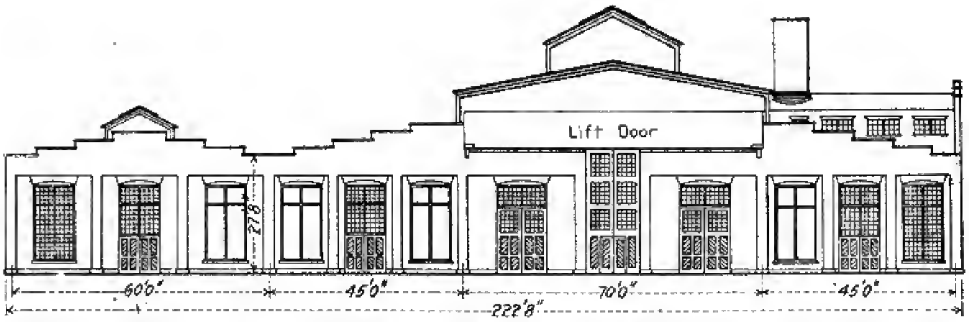
PLAN OF FOUNDRY AT READING, PA., P. & R. R. R.



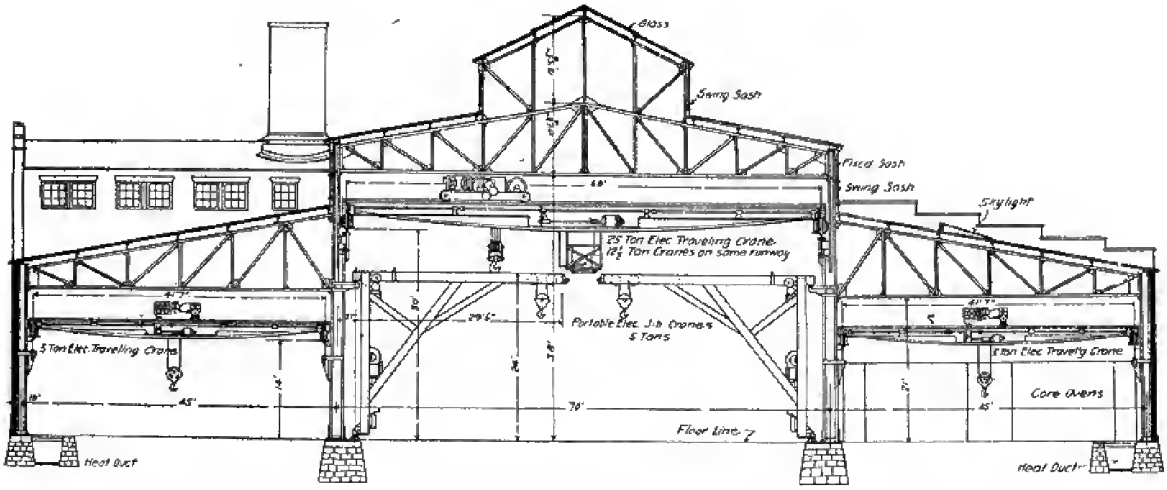
PLAN, ELEVATIONS AND SECTIONS OF PATTERN SHOP AND STORAGE BLDG. AT S. ALTOONA, PA., P. R. R.



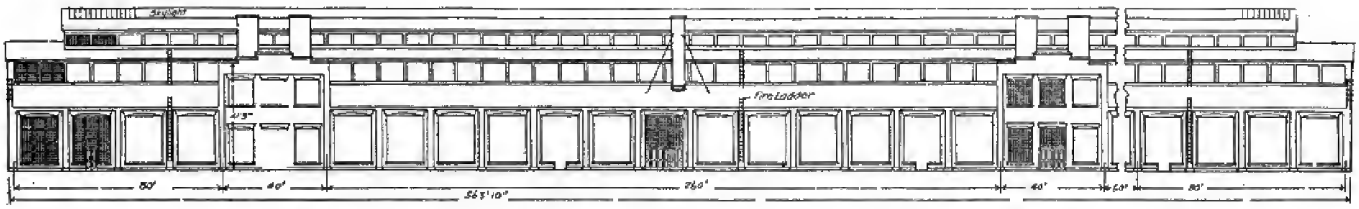
GENERAL LAYOUT OF FOUNDRIES AT SOUTH ALTOONA, PA., P. R. R.



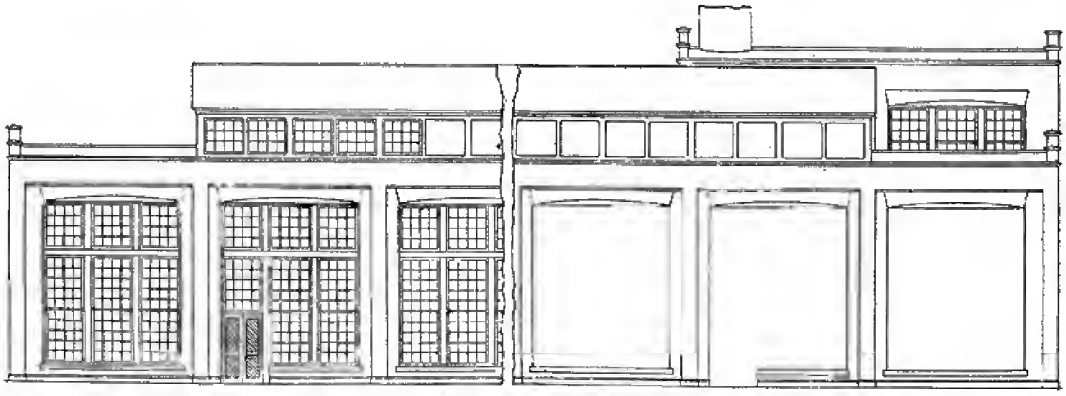
END ELEVATION OF GRAY IRON FOUNDRY AT SOUTH ALTOONA, PA., P. R. R.



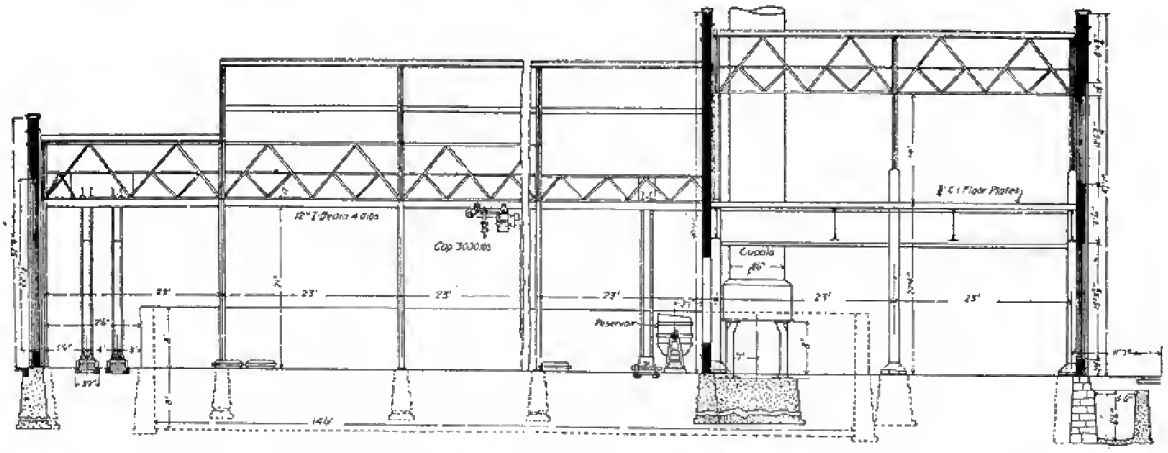
CROSS SECTION OF GRAY IRON FOUNDRY AT SOUTH ALTOONA, PA., P. R. R.



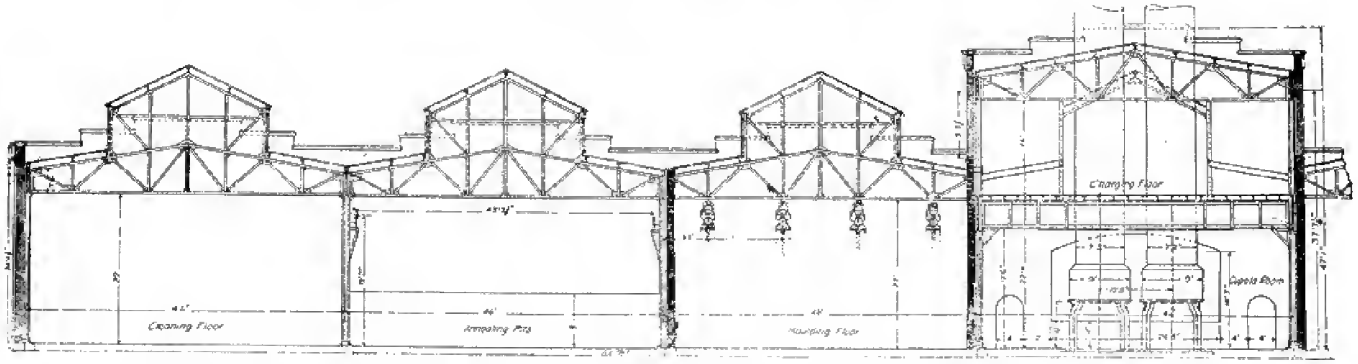
SIDE ELEVATION OF GRAY IRON FOUNDRY AT SOUTH ALTOONA, PA., P. R. R.



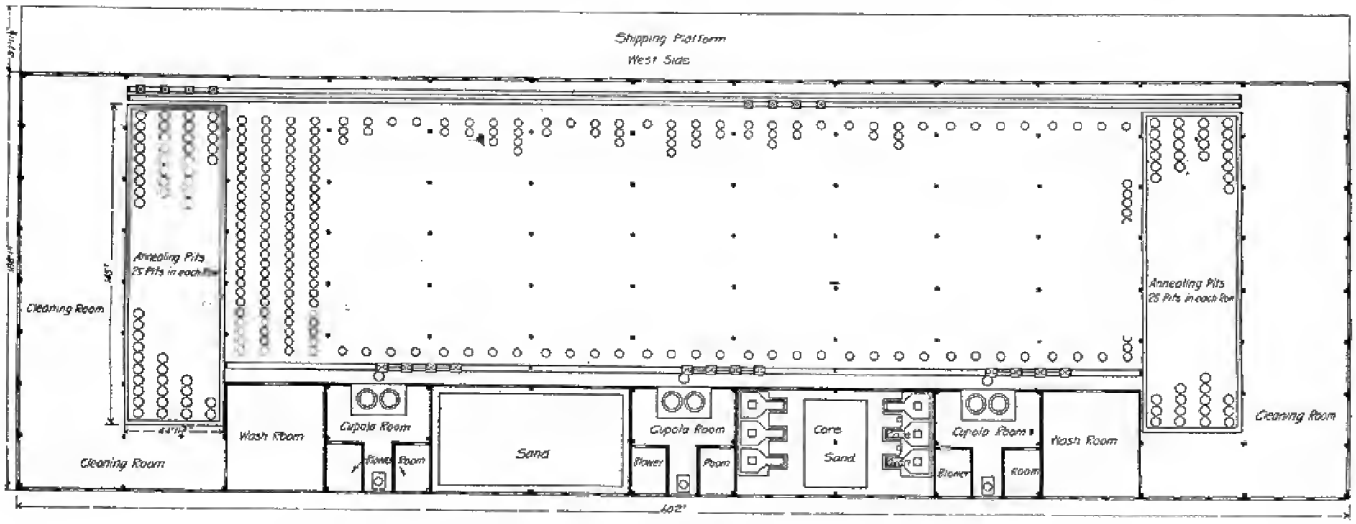
END ELEVATION OF WHEEL FOUNDRY AT SOUTH ALTOONA, PA., P. R. R.



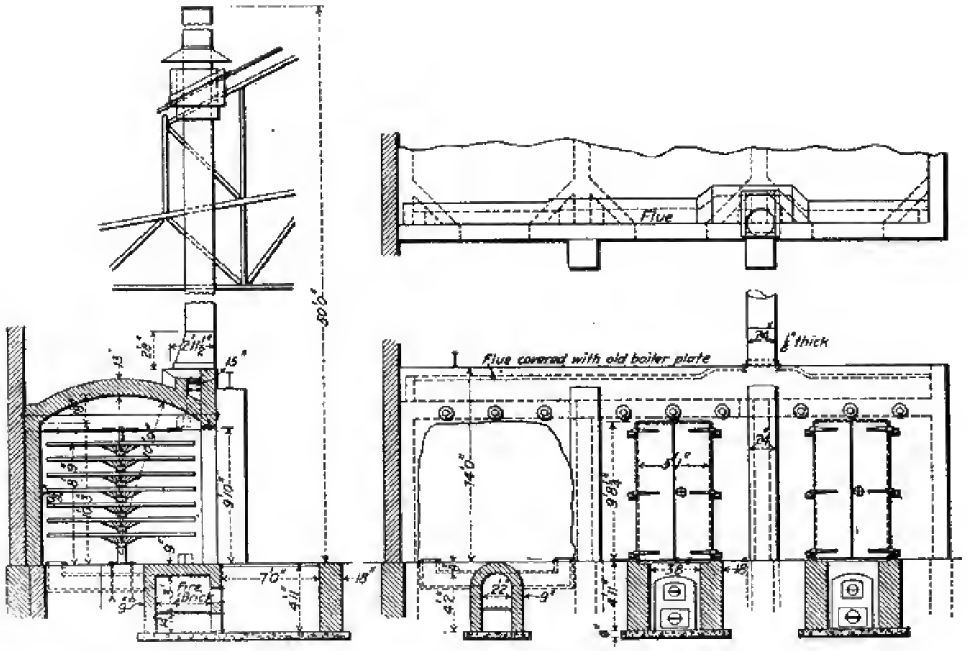
CROSS SECTION OF WHEEL FOUNDRY AT SOUTH ALTOONA, PA., P. R. R.



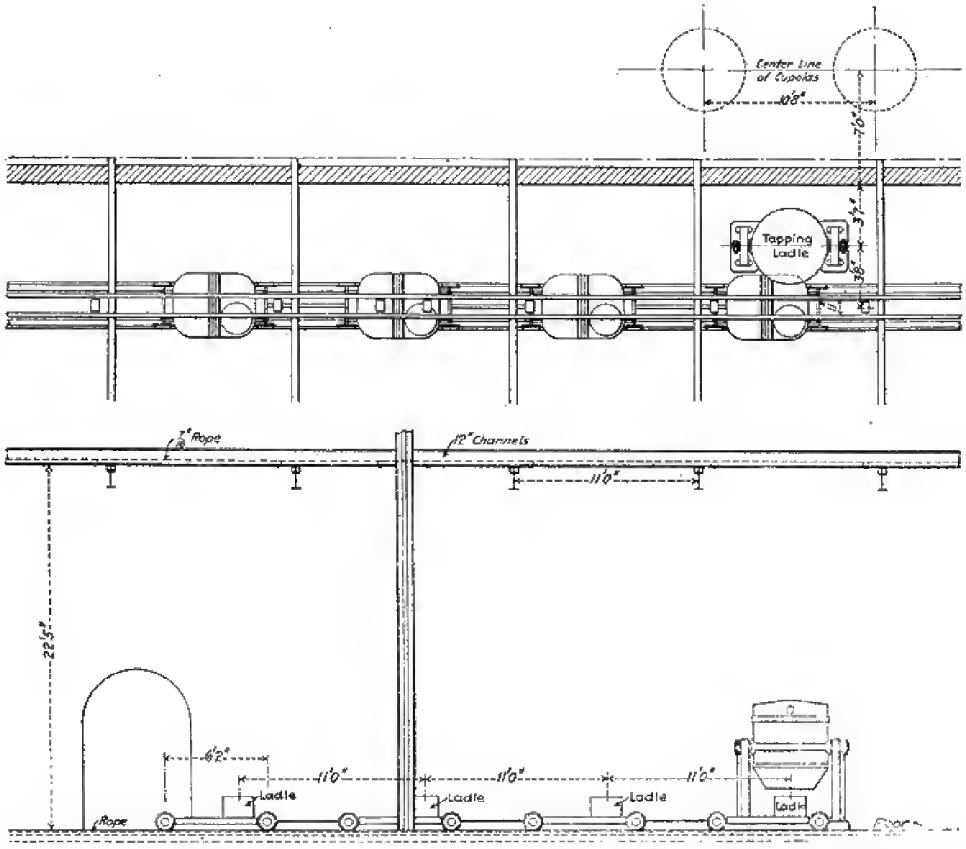
PARTIAL LONGITUDINAL SECTION OF WHEEL FOUNDRY AT SOUTH ALTOONA, PA., P. R. R.



PLAN OF WHEEL FOUNDRY AT SOUTH ALTOONA, PA., P. R. R.



DETAILS OF CORE OVENS IN WHEEL FOUNDRY AT SOUTH ALTOONA, PA., P. R. R.



ARRANGEMENT OF HOT LADLE CARS IN FRONT OF CUPOLA IN WHEEL FOUNDRY AT SOUTH ALTOONA, PA., P. R. R.